REPORT RESUMES

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REORGANIZED SCIENCE CURRICULUM, 4A, FOURTH GRADE SUPPLEMENT.
MINNEAPOLIS SPECIAL SCHOOL DISTRICT NO. 1, MINN.
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DESCRIPTORS- *CURRICULUM DEVELOPMENT, *CURRICULUM, *ELEMENTARY SCHOOL SCIENCE, *ECOLOGY, *GRADE 4, TEACHING GUIDES, ASTRONOMY, BIOLOGY, EARTH SCIENCE, INSTRUCTIONAL MATERIALS, PHYSICAL SCIENCES, SCIENCE ACTIVITIES, SCIENCE COURSES, MINNEAPOLIS, MINNESOTA,

THE FIFTH IN A SERIES OF 17 VOLUMES, THIS VOLUME PROVIDES THE FOURTH GRADE TEACHER WITH A GUIDE TO THE REORGANIZED SCIENCE CURRICULUM OF THE MINNEAPOLIS PUBLIC SCHOOLS. THE MATERIALS ARE INTENDED TO BE AUGMENTED AND REVISED AS THE NEED ARISES. THERE IS A DETAILED OUTLINE OF THE CONTENT FOR GRADE 4 FOR EACH OF THE FOLLOWING MAJOR AREAS AROUND WHICH THE CURRICULUM IS DESIGNED--(1) THE EARTH, (2) LIVING THINGS, (3) ENERGY, AND (4) THE UNIVERSE. A CHART INDICATES CONTENT FOR THE ENTIRE K-12 PROGRAM. THE FOURTH GRADE SUPPLEMENT IS IN TWO VOLUMES, 4A CONTAINS SECTIONS ON (1) CONCEPTS, AND (2) RESOURCE UNITS, AND 4B CONTAINS BIBLIOGRAPHIES AND EQUIPMENT AND SUPPLIES SECTIONS. RESOURCE UNITS ARE (1) AIR, (2) LIVING THINGS--ECOLOGY, AND (3) ROCKS. (DH)

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THE FOURTH GRADE SUPPLEMENT

to the

REORGANIZED SCIENCE CURRICULUM

Kindergarten Through Grade Twelve

(For Discussion Purposes Only)

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special school district no. 1
Minneapolis, Minnesota

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MINNEAPOLIS PUBLIC SCHOOLS
special school district no. 1
Minneapolis, Minnesota

March 1, 1965

FOREWORD

Long before that famous October fourth, 1957, when Sputnik I rocketed into orbit, the science teachers of the Minneapolis Public Schools eagerly began work on the reorganization of the science curriculum from kindergarten through grade twelve. This reorganized science curriculum was requested by our instructional staff and developed by representative members of that staff.

The citizen of today must be science literate in order to exercise adequately his duties of citizenship. The contribution of the scientist to our way of life is the methods which he uses to attack a problem and seek its solution. These methods are unique, but more important, they are very useful; they can be applied in the solution of the everyday problem by knowledgeable children at all ages and grade levels, and by adults in all walks of life. If these methods of science are to be learned by the youth of Minneapolis, they must be learned by attacking realistic problems inside and outside the classroom. This practice in the solving of work-a-day problems trains our young citizens to think for themselves in seeking new solutions to age-old problems of our civilization.

In the Minneapolis Public Schools we recognize that science is a very important part of the liberal arts general education which should be studied by all students. We are aware of our responsibility for instruction which must be well grounded in the fundamental laws and principles in all the fields of the basic sciences and therefore propose this reorganized curriculum for teaching the ever-expanding knowledge of science.

This reorganized science curriculum does not teach itself. It is a planned developmental approach in which the teacher is the expeditor and not the limiter of learning. The curriculum has been developed to aid the student in acquiring new breadths and new depths of understanding of his environment; and with it a teacher who is well trained in science may lead the student in an ever-expanding investigation of his surroundings in this world and universe. If the curriculum is used cooperatively by teacher and students, it is an instrument which can mold a pupil of the Minneapolis Public Schools into a science-literate citizen who, if he continues advanced science training, may become a scientist of the future.

Rufus A. Putnam
Superintendent of Schools

INTRODUCTION

This Supplement has been prepared as a convenient reference to assist the fourth grade teacher in teaching the science content allocated in the Reorganized Science Curriculum. Fourth grade teachers suggested and assisted with the preparation of each section of this Supplement. Those who have participated in the preparation of this Supplement lay no claim to its being "without blemish". However, its value can be determined only by those classroom teachers who use it and make constructive suggestions to improve it. All Minneapolis Public School personnel are invited to cooperate in improving this Supplement in order to make it of genuine assistance to all beginning and experienced fourth grade teachers. All constructive suggestions should be called in or sent to the Science Department Office.

This Supplement is not complete at the present time. When additional materials are developed, a copy will be furnished to you to place in this loose-leaf binder. Your cooperation with us to keep your Supplement up-to-date will be appreciated. When you leave your school, please leave the Supplement for the next teacher's use.

SUBJECT MATTER ALLOCATION

Grade Four

For discussion
purposes only

SUBJECT MATTER ALLOCATION

Grade Four

Note: This report recommends an order of presentation of science content and summarizes the concepts found in the Handbook. The examples used to illustrate each item are intended to stimulate thought association and not to restrict the presentation of this material.

INTRODUCTION TO SCIENCE

Attitudes (including history)

contributions of the study of science--investigation of changes, control of environment

Tools

aids to scientific investigations--laboratories, books, tools

Methods

techniques used in scientific problem solving--observing, stating the problem, gathering information, developing hypothesis, planned experiments, drawing a conclusion, testing of conclusion

LIVING THINGS

Ecology

factors which affect living things--soil, temperature fluctuations, amount of sunlight, inhabitants of the community

kinds of plant and animal habitats--prairie, desert, stream

adaptations of living things to their environment--camouflage, speed of movement, formation of protective coverings, seasonal changes

changes and balance in nature--food chains

interrelationships of living things within "communities"

competition among members of a species and between species for materials necessary for life--air, water, food, protection

evidence from fossil remains--habitat types in the past, records of kinds of plants and animals

Plant and animal economics

- useful plant and animal products--foods, fibers, lumber, medicine, stored fuels

- effect of plants and animals which destroy man's possessions--rodents, insects, bacteria

- living things which benefit man indirectly--insect pollination of plants

- effect of man on environments--wildlife management, reforestation, urban expansion

- man's influence on living things--hybrid plants, plant grafting, new varieties of animals, destruction of harmful organisms

- need for wise use of natural resources--conservation agencies, controlled harvesting of fish, use of plants to prevent soil erosion, destruction of natural habitats and useful organisms by careless burning

THE EARTH

History of the earth

- age and history of the earth--fossils, geological eras

Physical features

- physical characteristics of the earth--size, shape, layers of the earth

- physical features of the earth's crust--mountains, plateaus, valleys, oceans

- forces which wear away and build up new land forms--wind, water, volcanic activity, expansion of freezing water, glaciers

- differences between and effects of glaciers on the earth--drift deposits, valley formation

Rocks and minerals

- usefulness and value of earth materials--building materials, minerals, ores, mineral fuels

- examination of rocks by physical and chemical means--texture, streak color

- classification of rocks by study of their formation--igneous, sedimentary, metamorphic

Soils

- formation and composition of soils--grinding by glaciers, action of living things; sand, humus

- dependence of plants on soil--mineral needs, "leached" soils, drained lands

- conservation of soils--crop rotation, replacing minerals, contour plowing

ENERGY

Magnetic energy

characteristics of magnetic and magnetized materials--polarity of magnet magnetic attraction and repulsion, magnetic fields, aging of permanen magnets

magnetic characteristics of the earth--magnetic versus geographic poles, magnetic field of the earth

use of permanent magnets--compass, motors

THE EARTH

Water

forms (states) in which water occurs--water vapor, liquid, ice

sources of water--water table, reservoir, lakes

Air

layers in the earth's atmosphere--troposphere,ionosphere

factors affecting air pressure--weight and density of air; partial vacuum, compressed air

composition of air and uses of its constituents--nitrogen, oxygen, carbon dioxide, moisture; fertilizer, burning

causes of the movement of air--changes in atmospheric pressure, rotation of earth on axis

relation of condition in air to human comfort--air pollution, amount of water vapor

MINNEAPOLIS PUBLIC SCHOOLS
Science Department

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SUMMARY OF GRADE-CONTENT ASSIGNMENTS

Area and Major Topics	Grade Level K	1	2	3	4	5	6	7	8	9	10	11	12
Introduction to Science (Gray)	*	*	*	+	*	*	*	+	+	+	+	+	+
A. Attitudes (Including history)	+	+	+	+	+	+	+	+		+			+
B. Tools	+		+	+	+		+		*				+
C. Methods	+		+	*	+	+	+			*			

	K	1	2	3	4	5	6	7	8	9	10	11	12
I. The Earth (Red)	+	+	+	*	*	+		+	*				
A. History of the earth					+				+				
B. Physical features	*	+		+	+				+				
C. Rocks and minerals	+	*			+				+				
D. Soils		+		+	+				+				
E. Water	*		*	+	*			*					
F. Air	+	*		+	*			*					
G. Weather and climate				+		*			*				

ey to symbols -- * major emphasis
+ content to be taught

For discussion purposes only

Area and Major Topics	Grade Level												
	K	1	2	3	4	5	6	7	8	9	10	11	12
II. Living Things (Green)	+	+	+	+	+	+		*			*		
A. Life and life processes	+	+	+	+		*		+			+		
1. Life in general	+			*		+		+			+		
2. Food taking or nutrition		*	*	+		+		+			+		
3. Digestion								+			+		
4. Absorption						+		+			+		
5. Circulation				+		+		+			+		
6. Respiration						+		+			+		
7. Assimilation								+			+		
8. Oxidation						+		+			+		
9. Excretion				+		+		+			+		
10. Reproduction and growth		*	*	*		+		+			+		
11. Responsiveness	+	*	+	+		+		+			+		
B. Classification	*	+	+	+		*		+			+		
C. Ecology	*	+	*	*	*			+			+		
D. Plant and animal economics	+	+	+	*	*			+			+		
E. Human body	*	*	*	*		*		*			+		
F. Aesthetic values	*			*				+			+		

(continued)

Grade-content assignments (continued)

Area and Major Topics	Grade Level												
	K	1	2	3	4	5	6	7	8	9	10	11	12
III. Energy (Yellow)	+	+	+	+	+	+	+			+		*	+
A. Properties of matter related to energy	+			*			*			*		+	*
B. Sources and conservation of energy	+			+		*				+		+	+
C. Mechanical energy and simple machines	*		*	*			*			*		+	
D. Gravitational energy	+			+			+			+		+	
E. Magnetic energy	*		*	+	*					+		+	
F. Sound		*	*				*			+		+	
G. Electrical energy		*		*		*				*		*	
1. Static						+				+		+	
2. Current		*		*		+				*		+	
H. Communication bands and electronics												+	
I. Heat and infrared radiation	*			*		*				+		+	
J. Light and ultraviolet radiation	*	*	*				*			+		+	
K. High energy waves												+	
L. Chemical energy				+			*			*			*
M. Atomic energy							+			+		+	*

For discussion purposes only

Area and Major Topics	Grade Level K	1	2	3	4	5	6	7	8	9	10	11	12
IV. The Universe (Blue)	+	+	+	+		*	+		*	+			
A. Earth	+	*	*	*		+			+				
B. Moon	*		*			+			+				
C. Sun	*	*	*	*		+			+				
D. Solar system						+			+				
E. Stars and galaxies	*		*	*		+			+				
F. Space travel		+	+	+			*			*			

Key to symbols - - * major emphasis

+ content to be taught

Note: Conservation and safety must permeate science teaching at all grade levels.

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Grade Four

ALLOCATION OF CONCEPTS BY MAJOR TOPICS

Note: This report recommends an order of presentation of science content at each grade level and changes the order of the concepts found in the Handbook to provide a logical teaching approadh.

Fall

Introduction to Science

A. Attitudes (including history)

1. A person who questions and tries to find answers to scientific problems through logical processes is a scientist.
2. The study of science investigates the changes which constantly take place in all things.
3. Early scientists usually worked alone.
4. Mistakes in observations and conclusions are made by scientists of any era.
5. Man is increasingly able to control his environment.
6. Uncontrolled environment may become dangerous.
7. The use of knowledge acquired in scientific investigations is evident in daily life.
8. Many important scientific problems remain unsolved.

B. Tools

1. Many scientists do not make their observations in a laboratory.
2. Tools used in scientific experimentation must be properly maintained.
3. Many books and periodicals contain scientific information exclusively.

C. Methods

1. Clearly defining a problem may help a scientist discover the answer.
2. A problem may have a large number of possible solutions.
3. A problem may have only one best solution.
4. Some problems appear to be unsolvable.
5. A scientist refers to many sources of information.

C. Methods

6. To reach a valid conclusion an experiment must be repeated many times.

7. The greater the number of times an experiment is repeated and the greater the number of competent observers, the greater is the possibility of statistically accurate data.

8. All facts should be studied before a valid conclusion may be made.

9. Following a logical procedure in problem-solving may lead to a quicker solution.

10. In solving scientific problems the so-called "Scientific Method" may be used.

11. The usual steps in the so-called "Scientific Method" include the following:
    a. Observing, which usually leads to "cause and effect" questions;
    b. Isolating and stating the problem for investigation;
    c. Gathering information about the problem and previously attempted solutions;
    d. Developing an "educated guess" or hypothesis;
    e. Testing the hypothesis by planned experiments;
    f. Drawing a conclusion;
    g. Planned testing of the conclusion.

Fall

II. Living Things

C. Ecology

1. The sun is the direct or indirect source of all energy for life.

2. Living things occur in all types of habitats.

3. Some main habitat types are prairie, desert, forest, mountain, and stream.

4. Because of structural and functional characteristics plants and animals may flourish in a specific habitat.

5. In order for an organism to be successful in an area, an adequate supply of oxygen, food and water must be readily available.

6. In all environments living things compete with each other for existence and survival.

7. The water needs of any animal or plant are a major factor in determining its optimum habitat.

8. Some living things are able to remain alive for a long period of time on a limited amount of water.

9. Some living things are able to absorb more water than others.

10. The amount of surface and atmospheric water is a major factor in determining the type of habitat.

11. Different living things live in different environments or "communities".

12. Various environments furnish food for man.

13. Plants and animals which are successful in a specific environment had little or nothing to do with adapting themselves to the environment.

14. Some plants and animals have seasonal modifications.

15. Some animals live together for mutual benefit. (mutualism)

16. Some plants and animals live and grow on other plants or animals.

17. Brushing the teeth thoroughly removes the food particles which supply nutrients for bacterial growth.

18. Some living things depend on other living things to provide nourishment for them.

19. Some living things feed on the organic material of dead plants and animals.

20. Some plants and animals live and grow on dead plants and animals (saprophytes).

21. Different types of animals have different food requirements.

22. Some animals shift their food habits with the changes in food supply.

23. Insects sometimes use food which could be used by other animals.

24. Insects are considered essential to some plant and animal life.

25. Many plants are usually necessary to furnish the food for one herbivore.

26. Wild animals rove over a large area seeking an adequate supply of food.

27. Some animals are gregarious.

28. The kinds of domesticated animals may differ from one climatic zone to another.

29. Animals live successfully in different places because of their habits and adaptations.

30. Animals may live on the earth, in the earth and/or in water.

31. Animals which are natural prey of other animals often are able to escape due to the surroundings or speed of movement.

32. Some animals have protective colorations.

33. Some living things form protective coverings which enable them to survive unfavorable conditions.

34. Animals have various ways of protecting young.

35. The young of some animals receive no care from the parent.

36. The alarm note of some birds is noticed and heeded by some other animals.

37. Some animals migrate.

38. As winter approaches, some birds migrate to warmer climates where there is more available food.

39. As winter approaches, some animals eat excessively and go into hibernation during the coldest weather.

40. Some animals are able to hibernate or estivate in order to avoid extremes of temperature.

41. Wildlife plays an important part in the balance of nature.

42. Plants have different optimum habitats.

43. Most green plants need air, sunlight, minerals and water.

44. Plants of some kind grow on almost every part of the earth.

45. Plants of some kind grow in every climate.

46. Some plants appear to have become adapted to the climate in which they live.

47. Some plants flourish under conditions which are not conducive to the growth of other plants.

48. Some plants have structures which may protect them from enemies.

49. Most kinds of plants are adapted to living in the air.

50. Some plants are adapted to living under water.

51. Some plants are adapted to live in shady, cool areas and others live in sunny, warm areas.

52. Some plants and animals transmit diseases.

53. The stem aids a plant by supporting the leaves in a position to receive the sun's energy.

54. Most stems support their leaves to secure the most sunlight.

55. The arrangement of leaves on the stem of a plant usually enables the leaves to receive the maximum amount of sunlight.

56. When exposed to light, green leaves release oxygen and water to the atmosphere.

57. Most green plants in the presence of light are able to release oxygen as a by-product of photosynthesis.

58. Plants are directly or indirectly dependent on the soil.

59. Soils provide a medium suitable for the growth of many plants.

60. Most plants cannot obtain dissolved minerals and water from the air but must secure it from the soil.

61. Some plants contribute to the formation of soil.

62. Plants in order to remain successful in an area must have an adequate supply of water.

63. Seeds may be dispersed by environmental factors.

64. Man is dependent on plants to furnish food, clothing, shelter and some medicine.

65. Fossils furnish information about the organisms and types of habitats on the earth in the past.

66. Fossils are formed only from plants and animals which have hard parts.

67. Fossils of plants and animals are usually found in sedimentary rock.

68. Very little accurate information about dinosaurs is available.

D. Plant and animal economics

1. Man is dependent upon plants to furnish food, clothing, some shelter and many medicines.

2. For economic reasons man must supply conditions favorable to pla and animal growth.

3. Custom, prejudice and religion often determine which plants and animals shall be considered food.

4. Some animals naturally tend to aid man by destroying some of his enemies.

5. Some animals have become domesticated.

6. Man uses animals from various environments for food.

7. Man frequently processes animal-produced materials for food and other useful products.

8. Food which has been stored is frequently spoiled for human consumption by rats, mice and other rodents.

9. Frequently certain animals destroy some of man's possessions.

10. Insects are often man's chief rivals for the world's supply of food.

11. Insects destroy some of man's supply of fiber.

12. Many synthetic fibers are made from organic materials.

13. Cotton, flax, jute, hemp and other natural plant fibers are economically important.

14. Besides food and fiber, animals provide many other useful products.

15. Many commonly used fuels are organic in origin.

16. Wood and coal continue to serve as fuel in many areas.

17. Petroleum fuels are commonly used.

18. Lumber and wood products are frequently used for building materials, furniture, and a variety of articles in common

19. The cultivation of flowers and ornamental plants may be economically important.

20. By selection, man has developed varieties of plants and animals which are more useful to him.

21. Certain insects because of their structures and/or habits are good pollenizers.

22. Certain species of insects aid man by pollenizing useful plants.

23. Man may propagate some varieties of plants by grafting or budding.

24. Man has changed the characteristics of some plants by cross-pollination.

25. Hybrid animals or plants are usually produced by crossing one animal or plant with another animal or plant of the same variety.

26. Bacteria are harmful, harmless, or helpful.

27. Yeast plants form carbon dioxide which makes bread rise.

28. It is dangerous for an inexperienced person to harvest mushrooms.

29. In wise use of natural resources, the decisions or plans and programs should be made which will result in the greatest benefit to the most people for the longest time.

30. Conservation agencies are one of the chief means for disseminating information concerning intelligent use of resources.

31. Some natural resources are being replaced while some are not.

32. Erosion wears away valuable topsoil much faster than it can be built.

33. Plants are directly or indirectly dependent on the soil.

34. The use of plants in the conservation of soil is common practice.

35. Trees used as windbreaks may prevent erosion on plains.

36. Trees, shrubs and grasses are used to prevent soil erosion by wind and water.

37. Cultivation of land not suited for agriculture is wasteful destruction of natural habitats for plants and animals.

38. Man must protect plants and animals that help him.

39. Controlled harvest-taking of fish, game, and wild flowers is commonly provided for by well-defined laws.

40. Planned care, selective harvesting and reforestation will tend to assure future sources of timber, lumber and wood products.

41. Private wood lots help provide timber for farm fencing and other minor uses.

42. Restocking of lakes and streams with fry has been tried as a conservation measure.

43. Man should control plants and animals that are destructive to economic goods.

44. In order to survive, useful plants must compete successfully with noxious plants.

45. Weeds are often eliminated by burning.

46. Carelessness with matches destroys many plant and animal habitats.

47. Uncontrolled fires often destroy natural habitats of plants and animals.

48. Careless burning destroys many natural products useful to man.

49. Losses due to fires can be decreased by proper control measures.

50. Grass fires and campfires should always be extinguished before leaving them.

51. Preservation of some natural habitats is desirable for the education and pleasure of individuals and groups.

52. Proper management of wildlife is necessary to save certain species from extinction.

53. With the expansion of urban areas, man must set aside planned habitats for the protection and propagation of wildlife.

Fall and Winter

I. The Earth

   A. History

      1. The earth is a part of the universe.
      2. The earth is very old.
      3. The earth's surface is continually changing.
      4. The story of the earth is recorded in the rocks.
      5. There have been periods when the earth has undergone tremendous changes, with the formation of new land and water areas.
      6. Scientists are learning more about the earth's possible origin.
      7. Many sedimentary rocks contain fossils of former plant and animal life.
      8. The age of various parts of the earth can be determined by the kinds of rocks and fossils.
      9. Eras are usually measured by the absence or presence of fossils in the rock formations.
      10. Rocks found in Minnesota give us a clue to the early history of land formations in our state.

   B. Physical features

      1. The earth exerts a pull or force called gravity on all objects.
      2. The general shape of the earth is spherical.
      3. The earth is slightly flattened at the poles.
      4. The size of the earth can be measured.
      5. Scientists are investigating and studying about the earth's interior.
      6. There are many theories as to the characteristics of the earth's interior.
      7. For convenience of study, geologists divide the earth into layers.
      8. The earth's crust is composed of rock, soil and water.
      9. Much of the earth's surface is water.
      10. Some elevations of land surfaces are known as mountains, hills, plains and plateaus.
      11. A plateau is an elevated plain.

12. Volcanic activity occurs when the molten rock from deep in the earth rises to the surface and breaks through.

13. Some mountains are formed by volcanic deposits.

14. Lava flows are molten rock escaping to the earth's surface.

15. The continental shelf is part of the continent.

16. Weathering and erosion have changed the earth's surface.

17. Wind and water contribute to erosion.

18. Wind can cause the formation of sand dunes and snow drifts.

19. The earth's surface is worn away by moving water.

20. The natural caves found in Minnesota are formed in deposits of sedimentary rocks.

21. The ability to hold suspended materials decreases as speed of moving water decreases.

22. Some deposits of sediments on the earth's surface are caused by decrease in speed of moving water.

23. Valleys are formed and deepened by water erosion.

24. Swiftly moving water at waterfalls and rapids erode rock rapidly.

25. Large quantities of water are many times found between nonporous layers of rock.

26. Winter freezing and spring thawing increase the danger of avalanches on cliffs and hills.

27. Water freezing in rock crevices and faults expands causing the breaking up of rock.

28. A glacier is a slowly moving ice field.

29. Two factors which determine the rate of glacier formation are a large amount of precipitation and low temperature.

30. Many glaciers are a slowly moving river of ice.

31. A continental glacier moves in all directions.

32. Glaciers of the past ice ages helped change the earth's surface.

33. Glaciers erode the surface of the land and deposit drift.

34. U-shaped valleys are created by glaciers.

35. Many hills in Minnesota are the remains of various kinds of glacial moraines.

36. Glaciers were responsible for much of Minnesota's physical features.

37. Evidence of abrasive action of glaciers can be seen in Minnesota.

38. Some of Minnesota's lakes are located in depressions formed by the gouging of glaciers.

39. Physical features of the earth provide many opportunities for relaxation and recreation.

C. Rocks and minerals

1. Rocks are classified by formation and composition.

2. Rocks and minerals may be examined visually and some of them tested chemically to determine their classification and composition.

3. All rocks of the same kind are not the same color.

4. The color of a rock is of little value in identifying the specimen.

5. Many rocks when rubbed against other hard materials make a colored mark (streak).

6. Many tests, which are not chemical tests, may be used to aid in identifying minerals.

7. In rapidly flowing streams rocks are smooth and rounded because they are rolled and tumbled by the force of the water.

8. Most rocks do not burn.

9. Rocks are not melted easily.

10. Physical changes in rocks are caused by exposure to the changing weather.

11. Texture of rocks is changed by pressure and heat.

12. Rocks are formed in various ways.

13. Igneous rocks are formed by the cooling of molten materials.

14. Much of the earth, including some of Minnesota, is covered by volcanic igneous rock.

15. Pressures in the earth's crust may cause a change in the lower layers of rock found in the crust.

16. Metamorphic rock is rock which has been changed by heat, pressure and time.

17. Sedimentary rocks are formed of materials which are carried by wind or water into the lakes or oceans.

18. Sediments can be deposited by water running over low land.

19. Sedimentary rock is formed by the compacting and cementing together of individual particles in layers of sediment.

20. Rocks are useful to man in many ways.

21. Rocks contain minerals.

22. An ore may be a mineral.

23. Minerals, rock and ores are formed and located at various places on the earth's crust.

24. Minerals, rocks, and ores generally are consumed where they are economically profitable.

25. Some rocks in the earth's crust contain materials of economic value.

26. Some rocks in the earth's crust appears to be of little economic value.

27. Minerals, rocks and ores are used by industry.

28. Some types of rocks are used in building construction.

29. Coal, lignite and peat are not minerals, however, they are often referred to as mineral fuels.

30. Coal is usually a better fuel than either lignite or peat.

31. Natural gas is a fuel and should be used with care.

32. Petroleum is not a mineral; however, it is often referred to as a natural mineral.

33. Ores usually occur as deposits only in certain places and in unequal amounts.

34. Ores often must be refined to obtain the desired products.

35. Used or wasted minerals and rocks cannot be replaced.

36. Scientific and knowledge methods are used to conserve our natural resources.

37. Salt and water are used directly for the continuance of life.

D. Soils

1. Soil is composed of sand, clay and humus.
2. The building of soil requires a long time.
3. Some minerals formerly in rock are a part of the soil.
4. Living things helped build up soil on the earth's surface.
5. The roots of plants help keep soil from washing away.
6. Glaciers make soil by grinding rock to smaller particles.
7. High mountain tops have little or no soil.
8. Soil varies as to its suitability for plant life.
9. Different soils favor the growth of different varieties of plants.
10. Some soils may be improved for crop use by proper drainage and/or irrigation.
11. Water which comes to the earth in the form of rain, sleet or snow removes some soluble minerals from all soils (leaching).
12. Soils that have been depleted of their minerals lose their productivity.
13. Soil minerals are conserved by crop rotation.
14. To conserve soil productivity minerals must be replaced in proportion to their depletion.
15. The minerals, which plant growth removes from the soil, can be replaced by man.
16. Man can reduce undesirable erosion through proper farming practices, e.g., strip farming, contour plowing, crop rotation.

Winter

III. Energy

E. Magnetic energy

1. Magnetism is a form of energy.
2. The earth is a large magnet.
3. The earth has magnetic poles.
4. All magnets have two poles called the north and the south pole.
5. Like magnetic poles repel each other.
6. Unlike magnetic poles attract each other.
7. The magnetic poles of the earth do not coincide with the geographical poles.
8. In general, a magnetic compass tends to point toward the magnetic north.
9. Usually a compass does not indicate the true direction of the geographic poles.
10. True geographic north is not magnetic north.
11. The earth has a magnetic field.
12. There is a magnetic field around each magnet.
13. A magnetic field may be detected and described in terms of its action on other substances.
14. Magnets attract some objects through space with no visible connection.
15. The pattern of a magnetic field can be made visible ("mapped") by using small magnetic filings.
16. Permanent magnets may be used in many ways.
17. A magnetized bar or needle free to turn on a pivot (dip needle and compass) lines itself up in the earth's field.
18. Cobalt, nickel and iron are used to make alloys for strong permanent magnets.
19. Permanent magnets gradually lose their magnetism because energy is required to push the magnetic lines of force through the air.
20. Permanent magnets lose their energy rapidly by being placed in a strong magnetic field with reverse polarity.
21. Magnetism influences modern industry.
22. Magnets influence man's navigation.

Spring

I. The Earth

E. Water

1. Water is the most common liquid used by man.
2. The world's water supply is obtained from various natural and man-made reserviors.
3. Water may be found in or on the earth's surface.
4. Water that is not absorbed into the ground usually run off.
5. Dead plant and animal materials absorb and store water.
6. Water seeks its own level.
7. Water takes three states (solid, liquid, gas).

F. Air

1. The blanket of air around the earth is called atmosphere.
2. For convenience of reference, our atmosphere is said to be divided into layers.
3. The troposphere is that part of the atmosphere which contains moisture and is next to the earth's surface.
4. Clouds are masses of condensed water vapor floating in the troposphere.
5. The stratosphere is the layer of the atmosphere above the troposphere.
6. The ionosphere is an upper layer of the atmosphere.
7. Air occupies space and exerts pressure.
8. The air pressure at any place on earth varies with atmospheric conditions.
9. The pressure that air exerts can be measured.
10. Wind is caused by a change in atmospheric pressure.
11. Wind direction is affected by the rotation of the earth on its axis.
12. Winds may have either beneficial or detrimental effects on the earth's surface.
13. The weight and density of air decreases with altitude.
14. The weight and density of air decreases with an increase in temperature.
15. The weight of a given volume of air at standard temperature and pressure is constant.

16. Air may be compressed.

17. When an excess of air is forced into a closed container or a vessel it becomes compressed.

18. Only when all air is removed from a closed container is a vacuum developed.

19. Many industrial and domestic devices operate on the energy produced by a partial vacuum.

20. Burning fuels require large quantities of air (oxygen).

21. When inflammable materials rapidly oxidize and the liberated heat is not dissipated, they may suddenly burst into flames (spontaneous combustion).

22. When oxygen combines with a substance without noticeable light or heat, it is known as slow oxidation.

23. Oxidation of metals may be retarded by special treating or by coating them with substances.

24. The combination of oxygen with decaying plant and animal materials enriches the soil.

25. Nitrogen is the basis for many of our fertilizers.

26. Carbon dioxide, because it is heavier than air and noncombustible, is used as a fire extinguisher.

27. Some colors in commercial electrical signs are produced by one of the rare gases found in air; e.g., neon, argon.

28. The air which man breathes is a mixture of gases often including small particles of solid substances.

29. Bad effects on human health may result from various solid materials which man breathes in the air; e.g., smoke, fumes, dust and pollen.

30. Governmental agencies have taken steps to control air pollution.

31. Human comfort requires the year around control of temperature and humidity.

32. Human comfort is affected by the amount of water vapor in the air.

RESOURCE UNITS

AIR - a partial unit

Grade 4, Science

Some of the instructional learning experiences suggested in this partial unit were developed by Dr. Hervey Shutts at the science inservice education meeting for second year teachers on February 11, 1964. Others were taken from the resources listed. Dr. Shutts reviewed and edited the results.

The concepts and experiences listed here need not be presented in the order given. The manner and extent to which you will use these ideas should be determined by the needs of the children and your plans for the unit.

Sheila Fitzgerald
Helping teacher

SCIENTIFIC APPROACH TO PROBLEM SOLVING

1. Observation - first-hand experiences and observation.

2. Definition of PROBLEM - ask questions, choose one for investigation.

3. Results of other investigators - read about problem, discuss it with interested friends and resource people, examine the written material.

4. Possible solutions - list all possible guesses.

5. Choosing the best solution (HYPOTHESIS) - pick the "best guess."

6. Testing the hypothesis - planning and carrying out EXPERIMENTS to determine its truth.

7. CONCLUSION of accepting or rejecting hypothesis - draw conclusion from experiments to determine acceptance or rejection of "best guess."

8. More extensive testing of hypothesis - experiment further to determine if hypothesis always holds true.

9. Stating the THEORY and publishing results - restate the hypothesis in light of the above experimentation, publish in professional journal.

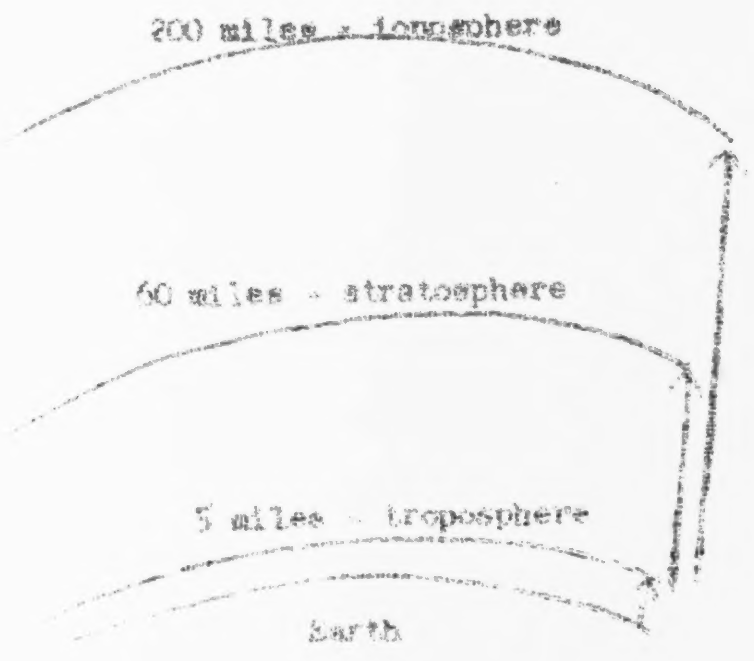
10. Finding mathematical proof - do any measuring and mathematical calculations to develop proof of theory.

11. Statement of LAW or PRINCIPLE - if no one can find a mistake in the mathematical proof or develop a contrary proof, the theory becomes a law or principle.

CONCEPTS 1 to 6

1. The blanket of air around the earth is called atmosphere.
2. For convenience of reference, our atmosphere is said to be divided into layers.
3. The troposphere is that part of the atmosphere which contains moisture and is next to the earth's surface.
4. Clouds are masses of condensed water vapor floating in the troposphere.
5. The stratosphere is the layer of the atmosphere above the troposphere.
6. The ionosphere is an upper layer of the atmosphere.

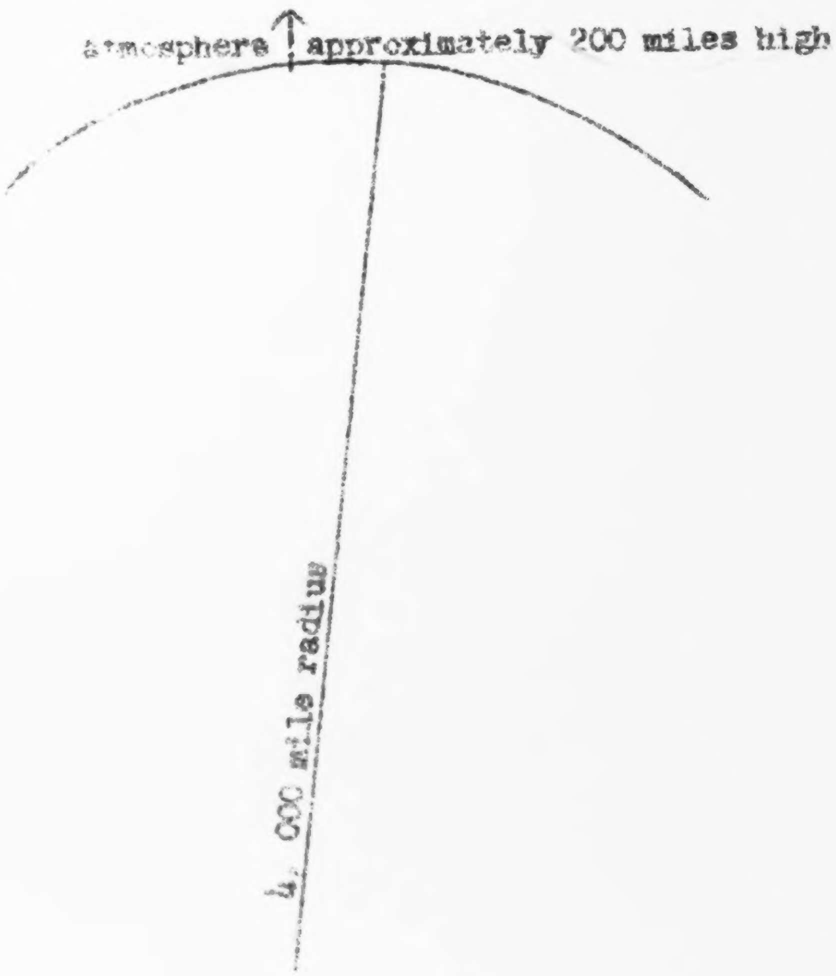
Experiences to build these understandings . . .



. Diagram with the children the three layers of air surrounding the earth. (Note that they are not distinct layers but a gradual thinning of the air). Scientists have divided the atmosphere into layers for clarification but there is no exact agreement on the depth of the layers.

What Is Air, pp 22-30

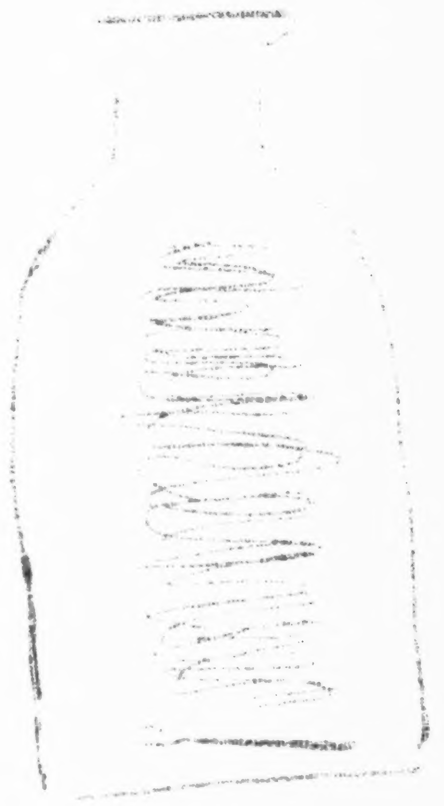
First Book of Air, pp. 12-18 and frontispiece



Help children discover the mathematical relationship of the height of the atmosphere to the radius of the earth.

Diagram

The atmosphere is approximately $\frac{1}{20}$ of the radius of the earth.



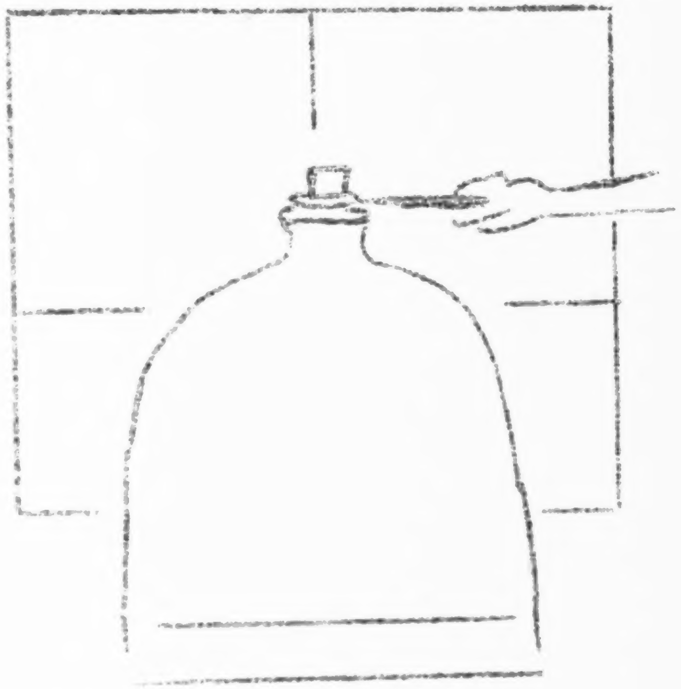
Make a cloud. Light a match and then blow it out. Drop the smoking match into a clear bottle or jar. Blow pressure into it (or put an inflated balloon over the top of the bottle and squeeze air into the bottle). Suddenly release the pressure.

Discuss:

Why is the smoke necessary?
(water vapor condenses on minute particles of smoke or dust)

Why is an increase in pressure necessary?

Why is there apt to be a heavier rainfall in the industrial sections of a city?
(You may want to arrange to conduct an experiment over a period of time involving your classroom and a classroom in another part of the city.)



jar
hot water
spoon
ice cube

Make a cloud. Fill a bottle with hot water. Pour out all but one inch. Set the bottle in warm sunlight. Hold an ice cube on a spoon over the opening of the bottle. A cloud will form.

Discuss:

From where did the water vapor come?

What cooled the water vapor and caused it to condense so we could see it?

Science in Your Life **Grade 4**, pp. 68-69

Other references:

First Book of Air, p. 40 - how clouds form

First Book of Air, pp. 41-42 } kinds of clouds
ABC Science Series Grade 3 }

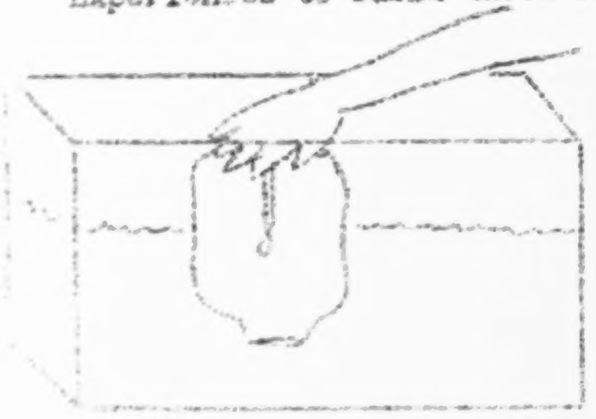
CONCEPTS 7 to 9

7. Air occupies space and exerts pressure.

8. The air pressure at any place on earth varies with atmospheric conditions.

9. The pressure that air exerts can be measured.

Experiences to build these understandings:



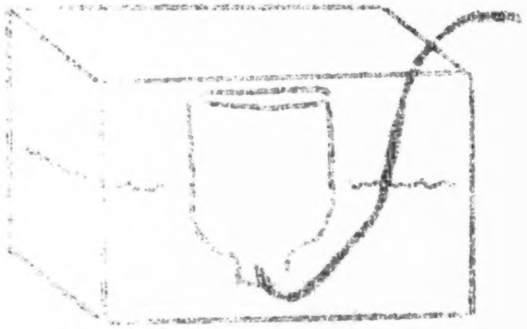
large glass container
          (aquarium)
two glass jars
stick match
clay
rubber tube
piece of bread, cloth,
  chalk, rope, sponge,
  blotter, soil

Air occupies space. Put the open end of a jar straight down into a glass container of water.

Do you see more than one bubble? Why not?
Tip it. What happened? Could you "pour" the bubbles from one jar to another? How?

Fasten an unlighted stick match to the bottom of a glass jar with a piece of clay. Put the open end of the jar straight down into the container of water. Remove the jar from the water.

Can you light the match?
Why didn't it get wet?



large glass container
glass jar
rubber tube
piece of bread, cloth,
   chalk, rope, dry sponge,
   blotter, soil

Fill a jar with water. Stand it upside down in a deep glass container half full of water. Blow through a rubber tube inserted into the bottle.

What happens to the water in the bottle? Why?

Put a piece of bread (cloth, chalk, rope, dry sponge, blotter, soil) into the water.

Why do air bubbles come to the surface of the water?

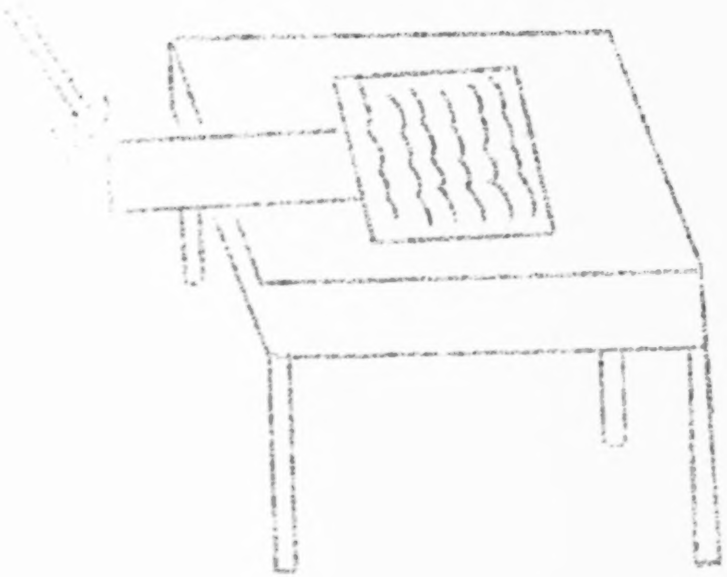
The Air About Us pp. 10-11 (also has many other experiment suggestions for this concept)

milk bottle
cardboard

Air exerts pressure. Fill a milk bottle with water. Cover it with a piece of cardboard and hold the cardboard with your thumb as you turn the bottle upside down. Carefully remove your thumb.

Why does the water stay in the bottle? (air pressure on the outside of the card is greater than the pressure of the water on the inside.)

First Book of Air p. 64



slat (piece of yardstick)
newspaper
hammer

Take a wooden slat from a crate (or an old yardstick). Put it on a table with 3 to 4 inches out over the edge. Lay some double sheet newspapers over the part of the slat on the table. With a hammer quickly hit the part of the slat sticking out bayong the table.

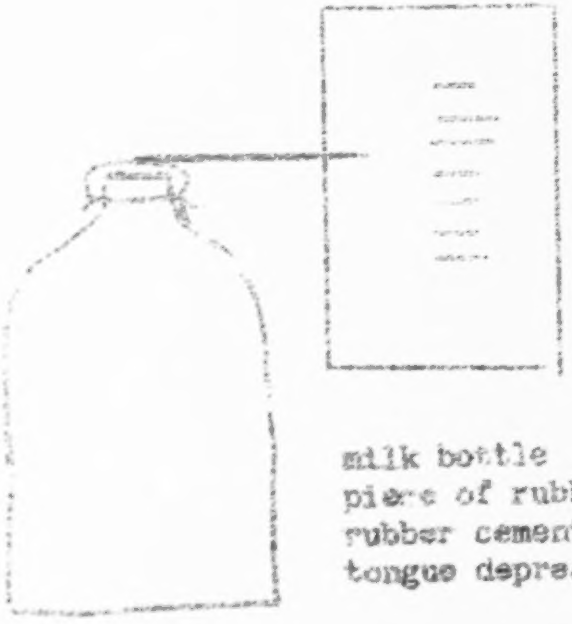
Why did the slat break and the newspaper stay in place? (the pressure of the air prevents the newspaper's quick movement)

First Book of Air p. 62

Discuss the principle of air pressure as applied in the use of soda straws, medicine droppers, rubber tires, vacuum cleaners, siphons, accordians, etc.

Other references:

The Air About Us pp. 19-23 - has many other experiment suggestions on air pressure
Air All Around pp. 19-25
ABC Science Series Grade 3 pp. 22-28



milk bottle
piece of rubber
rubber cement
tongue depressor

Measure air pressure. Make a simple aneroid (i.e. without liquid) barometer. Use a milk bottle with a piece of rubber (balloon) stretched over the top and held in place with rubber bands. Glue with rubber cement a tongue depressor (or a thin wooden splint or a sipper straw) to the center of the rubber diaphragm. Make a scale on cardboard or use a ruler in a vertical position. Read changes in atmospheric pressure as the diaphragm moves up and down.

Caution: Since air pressure changes with temperature this type of barometer is very inaccurate

First Book of Air p. 63

Other references:

First Book of Air pp. 20-24 gives the history of measuring air pressure and an explanation of mercurial barometers.

CONCEPTS 10 to 12

10. Wind is caused by a change in atmospheric pressure

11. Wind direction is affected by the rotation of the earth on its axis

12. Winds may have either beneficial or detrimental effects on the earth's surface

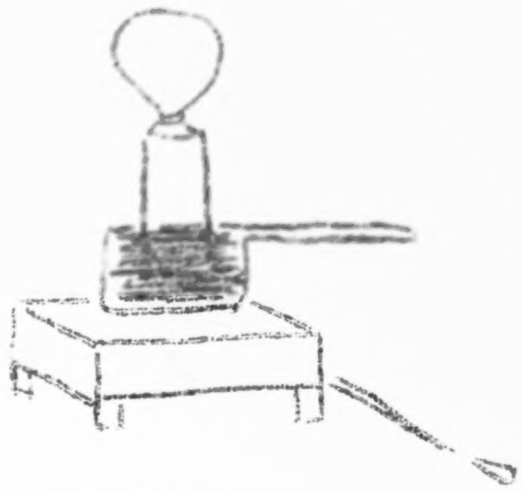
Experiences to build these understandings:

Candle holder

Warmed air expands and rises because it is lighter than cool air. Light a candle that is in a candle holder. Feel the air on all sides of the candle.

Where does the air feel the warmest? Why?

ABC Science Series Grade 3 pp. 56-57

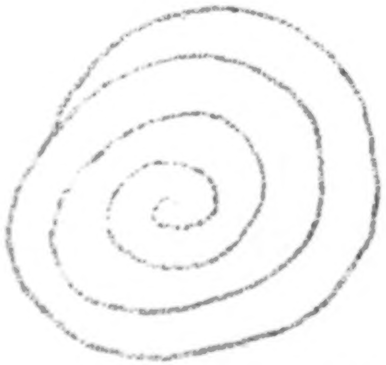


hot plate
pan
bottle
balloon

Squeeze the air from a balloon. Put it over the top of a cold bottle. Heat the bottle in water and watch the balloon expand.

First Book of Air p. 63

Make wind spirals. Cut a spiral from a circle of construction paper. Put it on a long pin with a bead to act as a bearing. Stick the pin into wood so the spiral can hang free. Put one spiral near the door, one above the radiator, one near the window, etc. Place one about 18" above a lighted candle or a lighted burner.

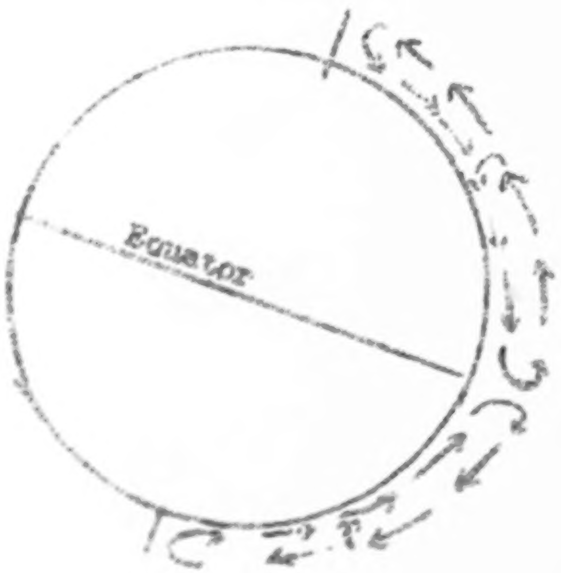


construction paper
display pins
beads
candle and holder
(or burner

Caution: Fire hazzard. Have a fire extinguisher handy.

Which spirals show the greatest movement? Why? What does this experiment tell us about air? As the warm air rises, what replaces it?

Examine a globe. What areas receive the greatest amount of direct sunlight? What will happen to the air near the equator? What kind of air will replace it? What kind of wind pattern will this create in the northern hemisphere? In the southern hemisphere? At what latitudes are the high pressure and low pressure areas?



First Book of Air pp. 48-49

With the axis of the earth vertical spin the globe (fast) from west to east. Use a medicine dropper and drop water near the North Pole. Allow the water to drain toward the equator.

medicine dropper

Why do the droplets turn to the right in the northern hemisphere? How does this experiment alter to some extent the wind pattern developed in the previous discussion?

First Book of Air pp. 51-52
Compton's Encyclopedia "Winds"

- Make a chart of ways winds help or hinder man's efforts. Discussion may develop ideas about erosion, flying kites, storms, fires, tailwinds, etc.

Other references:

The Air About Us pp 27-31 air toys to make.
ABC Science Series Grade 3 pp. 64-73 kinds of winds

CONCEPTS 13 to 15

13. The weight and density of air decreases with altitude.

14. The weight and density of air decreases with an increase in temperature.

15. The weight of a given volume of air at standard temperature and pressure is constant.

Experiences to build these understandings:

thermometer

. Altitude affects air. With a thermometer measure the temperature near the floor and near the ceiling of the classroom.

Which is lighter, cool or warm air? What does this tell you about the air close to the earth and the air high in the atmosphere?

. Develop an understanding of the meanings of the vocabulary included in the concepts:

decreases, weight, density, altitude, volume
increases, standard temperature, constant

Movies:

Air All Around Us
Young America, 1948; 10 min., black and white

Air in Motion
McGraw-Hill, 1956; 18 min., black and white

Understanding Fire
Coronet, 1956; 10 min.

The Wind at Work

Some references:

1. Fisher, James. *The Wonderful World of Air.* Doubleday, 1959.
2. Jacobson, Willard and Lauby, Cecelia. *ABC Science Series, Grade Three.* American Book Company, 1961.
3. Knight, David C. *The First Book of Air.* Franklin Watts Inc., 1961.
4. Parker, Bertha. *The Air About Us.* Row, Peterson and Company, 1959.
5. Pine, Tillie S. and Levine, Joseph. *Air All Around.* Whittlesey House, 1960.
6. Flitz, Albert. *What Is Air?* Benefic Press, 1960.
7. Podendorf, Illa, *101 Science Experiments.* Childrens Press, 1960.
8. Schneider, Herman and Nina. *Science in Your Life, Grade Four.* D. C. Heath and Company, 1961.

MAC:SF:dmf
March 9, 1964
Department of Elementary Curriculum

For discussion purposes only

A RESOURCE UNIT

II. LIVING THINGS

C. ECOLOGY

TO BE TAUGHT IN
GRADE FOUR

To be included in the Grade Four Supplement of the
Reorganized Science Curriculum

Minneapolis Public Schools
Science Department

January 4, 1965

For discussion purposes only

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For discussion purposes only

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For discussion purposes only

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For discussion purposes only

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WHAT IS ECOLOGY?

Neither plants nor animals can live for a long period of time without each other. One kind of plant or animal lives in an area inhabited by some other kinds of plants or animals. In most stable areas, plants and animals are in dynamic balance and each flourishes only as it is able to compete successfully for the energy sources.

Ecology is the study of the dynamics of all nature, involving all living things - from bacteria to oak trees and from single-celled protozoa to man. It includes a study of: (1) living things and how they form a pattern of life in the world around them; (2) the complex interrelationships which cause living things to be dependent upon each other as they compete for the same energy sources in an area; and (3) the effect of all factors of the physical environment on living things. Plant and animal communities, balance of nature, food chains, and web of life - all are phrases used to describe some of the many facets of this study.

I. INTRODUCTION

This resource unit contains some suggestions for learning experiences which can be used in developing a better understanding of the basic concepts of ecology which are teachable at a fourth grade level. It does not contain suggestions for experiences with which to teach each allocated concept. The classroom teacher undoubtedly knows many other experiences which can be utilized in the teaching of this unit. Since it is difficult to foretell the experiences which will produce the best learning with any specific group of children, each individual classroom teacher must use his own judgment in deciding which experiences are to be used with his specific class. The responsibility for planning and carrying out learning experiences to teach every concept included in this unit remains with the individual classroom teacher.

As the teacher uses this resource unit, he should remind himself continually that the development of scientific attitudes and a desire for further learning is more important than a knowledge of facts. As the unit progresses, the teacher should encourage the children to develop a vocabulary specific for this unit and help the children become more familiar with the new meanings for common words.

The teacher should make a conscientious effort to provide the children with opportunities to record information obtained as a result of observation, to compare the results of related experiences, to summarize the learnings, and to formulate useful conclusions about the interrelationships between living things and their environment. In this way the children will gain a broad, general understanding of the principles of ecology.

It is assumed that pencil and paper are available to the pupils at all times and these items are not included each time that recording of data or the making of a chart is important in a learning experience.

II. CONCEPTS INCLUDED IN THIS UNIT

Living Things

C. Ecology

1. The sun is the direct or indirect source of all energy for life.
2. Living things occur in all types of habitats.
3. Some main habitat types are prairie, desert, forest, mountain, and stream.
4. Because of structural and functional characteristics plants and animals may flourish in a specific habitat.
5. In order for an organism to be successful in an area, an adequate supply of oxygen, food and water must be readily available.
6. In all environments living things compete with each other for existence and survival.
7. The water needs of any animal or plant are a major factor in determining its optimum habitat.
8. Some living things are able to remain alive for a long period of time on a limited amount of water.
9. Some living things are able to absorb more water than others.
10. The amount of surface and atmospheric water is a major factor in determining the type of habitat.
11. Different living things live in different environments or "communities".
12. Various environments furnish food for man.
13. Plants and animals which are successful in a specific environment had little or nothing to do with adapting themselves to the environment.
14. Some plants and animals have seasonal modifications.
15. Some animals live together for mutual benefit. (mutualism)
16. Some plants and animals live and grow on other plants or animals.
17. Brushing the teeth thoroughly removes the food particles which supply nutrients for bacterial growth.

18. Some living things depend on other living things to provide nourishment for them.

19. Some living things feed on the organic material of dead plants and animals.

20. Some plants and animals live and grow on dead plants and animals (saprophytes).

21. Different types of animals have different food requirements.

22. Some animals shift their food habits with the changes in food supply.

23. Insects sometimes use food which could be used by other animals.

24. Insects are considered essential to some plant and animal life.

25. Many plants are usually necessary to furnish the food for one herbivore.

26. Wild animals rove over a large area seeking an adequate supply of food.

27. Some animals are gregarious.

28. The kinds of domesticated animals may differ from one climatic zone to another.

29. Animals live successfully in different places because of their habits and adaptations.

30. Animals may live on the earth, in the earth and/or in water.

31. Animals which are natural prey of other animals often are able to escape due to the surroundings or speed of movement.

32. Some animals have protective colorations.

33. Some living things form protective coverings which enable them to survive unfavorable conditions.

34. Animals have various ways of protecting young.

35. The young of some animals receive no care from the parent.

36. The alarm note of some birds is noticed and heeded by some other animals.

37. Some animals migrate.

38. As winter approaches, some birds migrate to warmer climates where there is more available food.

39. As winter approaches, some animals eat excessively and go into hibernation during the coldest weather.

40. Some animals are able to hibernate or estivate in order to avoid extremes of temperature.

41. Wildlife plays an important part in the balance of nature.

42. Plants have different optimum habitats.

43. Most green plants need air, sunlight, minerals and water.

44. Plants of some kind grow on almost every part of the earth.

45. Plants of some kind grow in every climate.

46. Some plants appear to have become adapted to the climate in which they live.

47. Some plants flourish under conditions which are not conducive to the growth of other plants.

48. Some plants have structures which may protect them from enemies.

49. Most kinds of plants are adapted to living in the air.

50. Some plants are adapted to living under water.

51. Some plants are adapted to live in shady, cool areas and others live in sunny, warm areas.

52. Some plants and animals transmit diseases.

53. The stem aids a plant by supporting the leaves in a position to receive the sun's energy.

54. Most stems support their leaves to secure the most sunlight.

55. The arrangement of leaves on the stem of a plant usually enables the leaves to receive the maximum amount of sunlight.

56. When exposed to light, green leaves release oxygen and water to the atmosphere.

57. Most green plants in the presence of light are able to release oxygen as a by-product of photosynthesis.

58. Plants are directly or indirectly dependent on the soil.

59. Soils provide a medium suitable for the growth of many plants.

60. Most plants cannot obtain dissolved minerals and water from the air but must secure it from the soil.

61. Some plants contribute to the formation of soil.

62. Plants in order to remain successful in an area must have an adequate supply of water.

63. Seeds may be dispersed by environmental factors.

64. Man is dependent on plants to furnish food, clothing, shelter and some medicine.

65. Fossils furnish information about the organisms and types of habitats on the earth in the past.

66. Fossils are formed only from plants and animals which have hard parts.

67. Fossils of plants and animals are usually found in sedimentary rock.

68. Very little accurate information about dinosaurs is available.

III. LEARNING EXPERIENCES FOR SPECIFIC CONCEPTS

Concept #2 - Living things occur in all types of habitats.
(Contributes also to Concept #3)

Experience A:

Materials needed:

Soil
Water
3-Aquarium
Charcoal
Gravel
Sand
Some plants and animals from a desert habitat
Some plants and animals from a Minnesota low woodland habitat
Some plants and animals from a Minnesota bog or swamp
Trowel

What to do:	Discovering that:
Refer to pages 495-497 in the 1958 edition of Science for the Elementary School Teacher by Craig for instructions in making terrariums. In the aquariums prepare (1) a desert terrarium, (2) a Minnesota low woodland terrarium and (3) a bog terrarium, duplicating as closely as possible the conditions of each environment as to soil, temperature, and moisture. Be sure to include some small specimens of the common types of animals and plants in each habitat. Consult Clifford Moore's, The Book of Wild Pets for information about the care of the animals. Observe the living things in each habitat for at least two weeks. Make a list of all the plants and animals in each habitat. Compare the types of plants and animals in one habitat to the plants and animals in the other habitats. After the habitat has been developing for a month or more, temporarily change the temperature and/or the moisture of each terrarium and record the observed changes as they take place. Summarize the comparisons and draw conclusions based on the observed evidence.	There are different kinds of habitats. All natural habitats contain living things. The types of plants and animals usually found in one habitat differ from those in other habitats.

Experience B:

Materials needed:

Spade
Magnifying glass
Newspaper or large sheet of plastic
(30" x 30" minimum)
Screen, coarse mesh
Screen, fine mesh

What to do:

Cut, dig up, and bring to the classroom one square foot of grass sod with soil about six inches deep. Place the sod on a table which has been covered with a thick layer of newspaper or a large sheet of plastic. Pull the sod and soil apart bit by bit very carefully watching for evidence of animals and plants. Sift the soil first through a coarse and then through a fine mesh screen. Examine the sod, soil, and screens, carefully looking for all the plants and animals which may be present. Use a magnifying glass when necessary. Record the number of each kind of living thing which is found. Draw conclusions based on the observations.

Do not allow soil to remain on the finished table top without adequate protection from moisture.

Discovering that:

Many plants and animals are part of the soil. The soil is a type of habitat.

Experience C:

Materials needed:

Paper, 3 sheets
Newspapers
Jar with cap

What to do:

Find some reference books in the library which describe different habitats and their characteristics. View the instructional film, "Animal Habitats."

Discuss in class the kinds of habitats which may be found in and around the school. What are the characteristics of each of these habitats?

Go out on the school grounds. Look for the various different habitats which exist there.

Compare these habitats to discover their similarities and differences. Prepare a chart listing these similarities and differences. Observe the plants and animals which exist in each habitat. Make a chart recording the names and kinds of plants and animals. See below for a suggestion. Collect a specimen of any living thing whose name is not known, place it in a jar or wrap it in newspaper, and take it back to the classroom to study and identify specimen. Make a map of the school grounds showing the location of the types of habitats. Summarize the observations.

Discovering that:

Many different types of habitats may occur in a rather small area.

Each habitat has different types of plants and animals which live there.

Example:

Habitat	Plants	Animals
Under a tree	grass, etc.	earth worms, etc.
Under foundation		
Shrubbery		
Near the building		

Concept #4 - Because of structural and functional characteristics plants and animals may flourish in a specific habitat.

Experience A:

Materials needed:

Plants from various habitats
Reference materials

What to do:	**Discovering that:**
Examine plants from various habitats, comparing the leaves, stems and roots. Compare and observe the difference. Consult references to find out about these differences between plants. Attempt to discover why specific plants are suited to a specific habitat. Make a chart to summarize the information collected. Refer to the chart below for some suggestions as to the type of information which may be found and observed.	Plants differ according to their habitat. A plant is usually suited to live in a specific habitat.

Habitat	Plant	Leaves	Stems	Roots
Desert	Cactus	small, waxy		
Upland Prairie	Sheep Sorrel	small	short	
Woodland	Violet	broad		
Swamp	Moss			shallow growing

Concept #5 - In order for an organism to be successful in an area, an adequate supply of oxygen, food and water must be readily available.

Experience A:

Materials needed:

3-Large jars, one gallon, without caps
1-Large jar, one gallon, with tight cap
Pond water
4-Toad tadpoles, small (available only in the spring)*
Hard boiled egg's yolk
Pond mud
Pond plants
Lettuce
Charcoal
Gravel, ¼" size
Sand
3-Gallons tap water which has been standing for one week

* The children may assist in bringing in toad tadpoles. A baitseller may be helpful in providing toad tadpoles.

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What to do:

Make each of the four one-gallon jars into a fresh water pond habitat aquarium. Refer to pages 495-497 of Craig's Science for the Elementary-School Teacher, 1958 edition, for instructions for setting up the aquaria. Allow the water to stand uncovered in the jar aquaria for at least one week before using. Number each of the four aquaria. Place one toad tadpole in each large glass jar aquarium. Consult pages 263 and 264 of Blough, Schwartz and Huggett's Elementary-School Science and How to Teach It, 1958 edition, for instructions for raising tadpoles. Observe the jars each day to determine any changes in structure or behavior of the toad tadpoles. Throughout this experiment Jar No. 1 is to be used as a control, because (1) the jar will be left open for needed oxygen to be absorbed from the air into the aquarium water, (2) food is to be given to the tadpole regularly, and (3) the water level is to be maintained constant throughout the experiment.

Feed the tadpoles in Jars No. 1, No. 2, and No. 4 small bits of a hard boiled egg yolk and a small leaf of lettuce every other day. Add no food to Jar No. 3. Jar No. 2 is to be sealed tightly

Discovering that:

Tadpoles require oxygen, food and water in order to live. When the amount of either oxygen, food or water becomes too small, the tadpoles die.

Experience A (continued):

Discovering that:

except when it is opened briefly to introduce the food regularly

The water level is to be maintained constant throughout the experiment in Jars No. 1, No. 2, and No. 3. No water is to be added as it evaporates from Jar No. 4. However, food is to be introduced regularly into Jar No. 4.

To reduce the evaporation of water from Jars No. 1 and No. 3, small sections of toothpicks or match sticks may be fastened with melted paraffin to the top edge of the jar at three equally spaced places. As soon as the paraffin hardens, a piece of glass window pane can be used to cover each of Jar. No. 1 and No. 3.

When water is to be added to Jars. No. 1 and No. 3, be sure to allow the tap water to stand in an open container for at least one full week before using it.

Observe the containers daily and record any changes in the environment and the effect of these changes on the tadpoles. Record any changes in the tadpoles. Draw conclusions based on these observations.

Recapitulation:

	Jar No. 1	Jar No. 2	Jar No. 3	Jar No. 4
Air	Leave open--glass cover	Seal tightly, except to feed	Leave open--glass cover	Leave open
Water	Keep water level constant	(No change should occur)	Keep water level constant	No water added (allow to evaporate)
Food	Feed regularly*	Feed regularly*	Do not feed	Feed regularly*

*Food to be - hard boiled egg yolk and lettuce

For Over-achievers:

Watch the tadpole as it develops into a toad (?) in Jar No. 1. Do any changes become evident in their breathing equipment? Does the oxygen source or requirements differ with a change in the breathing equipment?

Experience B:

Materials needed:

Potted plant
Water
Tincture of iodine, diluted 5 times
  with water, (add a crystal of potassium
  iodide if it is available)
Medicine dropper
Mortar and pestle
Aluminum meat pie tin

What to do:	Discovering that:
Remove a leaf from the plant. Crush the leaf in a mortar and pestle. Place a few drops of water on the crushed leaf. Test for the presence of starch by placing a drop of tincture of iodine on the leaf. Put the plant in the dark for several weeks. Observe the plant daily and record the observation until no further change takes place. Remove a leaf from the dead plant and test it for the presence of starch. Compare the results of the two starch tests. Explain the difference in the starch test results. Draw conclusions based on the results.	A plant must obtain light in order to make its food. A plant must have certain foods in order to live.

Experience C:

Materials needed:

Aquatic plant or animal

What to do:	Discovering that:
Remove an aquatic plant or animal from its aquatic habitat. Lay it on the window ledge. Observe the living thing closely to see if a change takes place. Explain the observations. Draw conclusions based on the observation.	Some plants and animals must be surrounded by fresh water in order to live.

Experience D:

Materials needed:

10-Aluminum meat pie tins
10-Lima beans
Potting soil
Water

What to do:	Discovering that:
Plant a lima bean in soil in each of the 10 aluminum pie tins. Water the soil when necessary, taking care to avoid using too much or too little water. Dig up one of the seeds after three days and examine thoroughly. Record what is seen with a sketch referring to the parts of the seed which change during germination. Dig up one seed each day thereafter; examine it carefully. Keep a record of each day's observation. Explain the differences observed in the seeds. Draw conclusions based on the observations.	There are names for the parts of a lima bean seed. As the seeds germinate the seedling develops and the food stored in the seed is used.

Concept #6 - In all environments living things compete with each other for existence and survival.

Experience A:

Materials needed:

2-Wooden boxes, about 12" x 18" x 2"
Fertile soil
Radish seeds
Water

What to do:	Discovering that:
Fill both wooden boxes to a depth of 1½" with fertile soil. Dump a small handful of radish seeds into the center of one box of soil. With a sharpened pencil make very shallow holes about ½ inch apart in rows ½ inch apart in the other box of soil. Drop one radish seed in each hole. Cover all the seeds with 1/8" of soil. Keep the boxes in the light and water daily. Observe the boxes daily and compare. Record the observations. Explain the observations.	Seeds which are too close together do not grow as well as seeds which are spaced apart. Plants which are crowded together shade one another and compete for the available water and light.

Concept #10 - The amount of surface and atmospheric water is a major factor in determining the type of habitat.

Experience A:

Materials needed:

3-Aquariums
  Soil
  Pond plants and animals
  Bog plants and animals
  Woodland plants and animals
  Pond mud
Bog soil
Hygrometer, Humidiguide
Pencil
Paper
Woodland soil

What to do:	Discovering that:
Make a terrarium representing a mud-bottomed shallow pool. Consult pages 491-493 in *Science for the Elementary-School Teacher* by Craig, 1958 edition for suggestions. Observe and record the characteristics of each of the plants and animals found. Observe and record the amount of surface water and the relative humidity of the atmosphere in the natural habitat. Make a bog terrarium. Observe the plants and animals in the bog and record their characteristics. Observe and record the amount of surface water and relative humidity of the atmosphere in the habitat. Make a woodland terrarium. Observe and record the characteristics of the plants and animals found. Observe and record the amount of surface water and the relative humidity of the atmosphere in the habitat. Compare the plants and animals in all three habitats. Compare the amounts of water in each habitat. Drain some water from each habitat and add soil. Observe the changes in the plants and animals and record the observations. Observe the amount of surface water and the relative humidity in each terrarium. Summarize the observations and draw conclusions based on the observations.	The difference in the plants and animals which live in each type of habitat is largely determined by the amount of water contained in the habitat. Some habitats have more surface water than others.

Concept #11 - Different living things live in different environments or "communities."
Other concepts which could be included: 1, 2, 42, 47, 50.

Experience A:

Materials needed:

Pencil
Paper

What to do:	Discovering that:
Visit a pond, lake or stream. Observe and record the kinds of living things seen. Write a description of each plant or animal if the actual name is not known. Describe the area in which each living thing is found. Visit a different pond, lake or stream. Observe and record the kinds of living things seen. Describe the environment in which each living thing is found. Compare the two ponds, lakes or streams. Determine whether the same kinds of living things are found in both places. Visit a vacant lot. Observe and record things seen. Find out if more than one kind of environment might exist within that area. Compare the living things found in each environment within the vacant lot. Compare the living things found in each environment in the water community to the living things found in each environment in the vacant lot. Summarize the results. Explain the observations.	Each kind of community contains plants and animals suited to that particular environment. Each community contains both plants and animals.

Experience B:

Materials needed:

Rubber cement
Scrapbook
Pencil

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What to do:

Collect pictures of natural or man-made communities* and put them in a scrapbook. Label the different communities with an appropriate name. Explain how different types of communities can be identified.[@] Draw conclusions concerning the probability of finding a specific plant or animal living in many different kinds of communities.

*(North side of building, south side of building, lawn, bare playground, swamp, pond, lake, park, black top or pavement, a vacant lot, etc.)

[@] Locate and visit as many of the above communities as possible within six blocks of your building.

Discovering that:

It is possible to identify various types of communities by the animals or plants found there.

Experience C:

Materials needed:

- Pencil
- Paper

What to do:	Discovering that:
Look out of the classroom window. See how many kinds of communities can be visually recognized. Make a list of the kinds of communities. Make a chart listing the communities and the kinds of living things which we might expect to find in each community. Explain why the same living things do not live in the different types of communities. Draw conclusions concerning the probability that a plant or animal can live in more than one kind of community.	To learn that a school area may contain more than one kind of community.

Experience D:

Materials needed:

- Shovel or spade
- Magnifying glass
- Newspaper

What to do:	Discovering that:
Examine a piece of sod as described in experience B , Concept #2. Identify some of the most common plants and animals present. Search other kinds of environments in the school yard to discover whether these same kinds of living things are found. Explain the observations. Draw conclusions based on the observations.	The plants and animals which live in the soil are not found in other environments.

Experience E:

Materials needed:

- Soil
- Water
- 2-Aquariums
- Charcoal
- Gravel
- Sand
- Trowel
- Aquatic plants
- Aquatic animals
- Sphagnum moss
- Old shoe or rotten log

What to do:

Compare the kinds of living things placed in the terrariums prepared for experience A, Concept #2. Prepare an aquatic community. Consult Science for the Elementary-School Teacher by Craig for directions. Make a fungarium by placing an old shoe or a chunk of a rotten log on moist sphagnum moss in an aquarium tank. Place the covered fungarium in a dark warm place for two weeks. Contrast the kinds of living things in the different artificial communities. Explain what makes the communities different. Draw conclusions based on the observations.

Discovering that:

Different communities contain different kinds of living things.

Concept #12 - Various environments furnish food for man.
Other concepts which could be included: 44, 45.

Experience A:

Materials needed:

Pencil
Reference books
Paper

What to do:

Make a chart listing the plants and animals found in different environments which are used for food by man. See the chart below for some suggestions.

Consult the reference books to list as many plants and animals as possible. Draw conclusions based on the chart.

Discovering that:

Foods for man come from many kinds of environments.

Examples:

Desert		Forest		Prairie	
Plants	Animals	Plants	Animals	Plants	Animals
Prickly pear	Snake Hare Wild-pig	Gooseberry Juneberry Currants	Deer Squirrel Bear	Dandelion Berries Mustard-greens	Rabbit Ground squirrels

Swamp		Lake		Ocean	
Plants	Animals	Plants	Animals	Plants	Animals
Cranberry	Ducks Geese Turtle	Wild rice	Gamefish Turtle	Kelp (Indirectly)	Oysters Fish Turtle

Experience B:

Materials Needed:

Unprocessed plant foods
Paper
Pencil
Reference books

What to do:

Make a display of many unprocessed plant foods which are used by man. Label each plant food and include the name of the part of the world in which the plant grows easily. Consult several reference books to find what home grown foods are used by people living in different areas of the world. Make a chart of the parts of plants used for food and give the name of each food used by other people of the world, similar to the chart below which is made for some of the plants of Minnesota. Extend this table if you can. Study reference books to discover whether all of the plants listed live in the same kind of environment. Draw conclusions based on these charts.

Discovering that:

Different food plants are used in different areas of the world.

Parts of Some Plants We Eat in Minnesota

Seeds	Stems	Roots	Leaves	Fruits	Flowers
Grains	Potatoes	Carrots Beets	Celery Dandelion Lambs quarter Lettuce Mustard greens Rhubarb (not blade) Spinach	Apples Cucumbers Elderberries Grapes Strawberries Tomatoes	Cauliflower Broccoli

Experience C:

Materials needed:

Paper
Pencil
Reference books

What to do:	Discovering that:
Make a list of Minnesota animals which are used for meat; include wild animals as well as domesticated animals. Consult reference books for help in preparing the list. Study reference books to discover whether all the animals listed live in the same kind of environment. Draw conclusions based on the results of your study.	Many animals from different environments in Minnesota are used for food by man.

Concept #14 - Some plants and animals have seasonal modifications.
(Contributes also to concepts 37, 38, 39 and 40.)

Experience A:

Materials needed:

Pencil
Paper
Pictures
Glue
Reference materials

What to do:	Discovering that:
List the animals which usually hibernate during the winter. (Pictures with labels are effective.) Consult reference to find in what kind of place each animal hibernates and how long each animal usually hibernates. Include the above information in a chart. Explain why only certain animals hibernate. Draw conclusions based on the chart.	Some animals hibernate. Animals select places protected from the weather in which to hibernate. Animals hibernate during certain seasons of the year.

Experience B:

Materials needed:

Pencil
Paper
Reference materials

What to do:	Discovering that:
Make a list of the animals which may estivate during hot, dry seasons. Consult reference materials for help in this project. Include in a chart the description of the places in which each animal may estivate and the length of time usually spent in estivation. Explain why some animals estivate. Draw conclusions based on the chart.	Some animals estivate during certain seasons of the year. Some animals estivate to avoid high temperatures and the loss of body moisture.

Experience C:

Materials needed:

Pencil
Paper

What to do:	Discovering that:
Observe specific birds in both warm weather and in cold weather. (In some areas a bird feeder might be used as a "watching" spot. If used during the winter, it should be continued until spring or birds may starve.) Note the changes in each bird's appearance when the temperature changes. Sketch a winter bird which is observed. Explain how and why the bird's appearance is different from that in summer. Draw conclusions based on these observations.	Some birds have slightly changed appearance at different temperatures. Birds fluff their feathers in winter to form small air spaces which help to insulate their bodies from cold and conserve their heat.

Experience D:

Materials needed:

Grasshoppers, small
Ice
Water
2-Medicine bottles, large flat sided
Baking pan, or dish pan

What to do:	Discovering that:
Place a few small grasshoppers in each large medicine bottle. Cap the bottles tightly. Place one bottle on its side in a container of ice water, taking care to keep the insects in both bottles in the same amount of light. Allow the bottle to remain in the ice water for 15 to 20 minutes. Note the activity of the grasshoppers in each bottle. Time occasionally the rate of the pulsation of the abdomen which indicates the rate of breathing or respiration. Record the observations. Compare the rates of breathing of the grasshoppers in the two bottles. Draw conclusions based on the comparison.	Cooler weather tends to make grasshoppers less active. The rate of breathing decreases as the temperature decreases.

Experience E:

Materials needed:

- Pencil
- Paper
- Clock
- Ice
- Water
- Thermometer, Centigrade (Celsius) or Fahrenheit scale
- Small fish or minnows
- Aquarium tank, about 6 gallon
- Aquarium tank, about 3 gallon
- Aerator and stone breaker

What to do:	Discovering that:
Place a small fish or some minnows in the small aquarium tank of water. Cool the smaller aquarium containing the fish by placing it in the larger aquarium of ice water. Take care to keep the fish exposed to the same intensity of light. Keep the aerator operating. Watch the activity of the fish. Note any change in the rate of movement of the gill-coverings. Count the gill-covering movements per minute. Use a thermometer floating in the inner aquarium to record temperature. Record the number of gill-covering (operculum) movements per minute and the temperature of the water. Repeat the count at several different temperatures as the water cools. Relate this activity of the fish to the temperature of the water. Draw conclusions based on the results.	Fish are less active when the temperature of the environment is reduced.

Experience F:

Materials needed:

Pencil
Paper

What to do:	Discovering that:
Record the appearance of the leaves and twigs of a deciduous tree in early autumn and again just before they fall. Examine the twigs after the leaves drop and at regular intervals throughout the winter. Note any change in appearances of the bud scales. Record all observations and the dates. Observe the parts of the twig that grow. Record all observations and the dates. Examine the twig in the spring as the buds begin to swell and leaves begin to appear. Summarize the observations. Draw conclusions based on the observations.	The twigs on a tree change at various seasons because of changes in environmental conditions. The buds and bud scales on a deciduous tree expand during the fall, winter and in spring before the leaves appear.

Experience G:

Materials needed:

- Pencil
- Paper

What to do:	Discovering that:
At monthly intervals throughout the year observe and record the kinds of plants and animals found around or on a tree. Compile a summary list. Compare the monthly lists of plants and animals to discover what plants and animals are found on or near the tree during each season of the year. Summarize the results. Draw conclusions based on the observations.	As the seasons change, different plants and animals may live in the same habitat.

Experience H:

Materials needed:

Sharp knife
Lilac sapling
Pencil
Paper

What to do:	Discovering that:
Use a sharp knife to cut away a shallow ring of bark around a lilac sapling in the late winter. Observe the ring as the season progresses. Record the observations. Propose some possible explanations for the observations. Draw conclusions based on the observations.	Constituents of the sap are stored in the roots of a plant during the winter and rise in the bark in the spring. Sap oozes out of the wood-covering, at the ring, as the season progresses and changes to spring.

Experience I:

Materials needed:

3-Potted plants, (such as coleus)
Electric fan
Ice
Water

What to do:	Discovering that:
Completely immerse one of the pots containing a healthy coleus plant in ice water for 15 to 30 minutes. Remove the pot from the ice water. Let air from the electric fan blow on the stems and leaves of the plant which has chilled roots. Let air also blow on the stems and leaves of a plant which was not chilled. Observe both coleus plants. Compare the results. Draw conclusions based on the observations. Suggest an explanation for the observations.	Chilled roots do not readily absorb water from wet soil. A plant wilts when its roots are cold and a current of moving air blows over the leaves causing excessive evaporation.

Concept #15 - Some animals live together for mutual benefit (mutualism).

Experience A:

Materials needed:

Magnifying glass

What to do:	Discovering that:
Look for some aphids and ants as they move about on the stems of certain garden plants. Use a magnifying glass if necessary to observe whether the aphids and the ants live together. Observe the activities of the aphids and ants for a period of time. Record each observation. Explain the apparent relation between the aphids and the ants.	Ants and aphids sometimes live together for mutual benefit. Some ants take care of some kinds of aphids. Some aphids provide food for ants.

Experience B:

Materials needed:

- Large glass jar, about 1 gallon capacity
- Shovel
- Trowel
- Paper
- Pencil
- Black paper
- Honey
- Water
- Sponge
- Rubber band
- Cheese cloth, marquisette or wire screen, (very fine mesh)

What to do:	Discovering that:
Locate a lively ant hill. Dig up the ant colony and place as many ants as possible in the jar. Put as many of the eggs, larvae, and pupae as possible in the jar. Make a special effort to capture the queen, which can be recognized by her enlarged abdomen. Provide food and moisture for the ants by moistening a small piece of sponge with equal parts of honey and water and placing it on top of the dirt in the jar. Cover the top of the jar with very fine mesh cheese cloth, marquisette or wire screen. Place a rubber band over the cheese cloth and the jar opening to hold the cheese cloth in place. Place the black paper around the jar. After several days, remove the dark paper temporarily to observe the ants as they work. Observe the ants for short periods of time during several days. Attempt to discover what each ant does. Try to find the relation between the different types of ants. Record all observations. Draw conclusions based on the observations.	Ants appear to help one another and the colony. Different ants do different kinds of work.

Concept #16 - Some plants and animals live and grow on other plants or animals.

Experience A:

Materials needed:

Magnifying glass
Razor blade or sharp knife

What to do:	Discovering that:
Go for a walk along a country road in the late fall after frost. Look for and collect the stems of goldenrod which have the large round gall near the center of the stem. Use a razor blade, or sharp knife, to open the gall and examine the contents. Explain the contents of a goldenrod gall. Record all observations. Draw conclusions which you can concerning a relation of the goldenrod gall to the possible causes of its formation.	When certain insects puncture the stem of the goldenrod plant to lay its eggs, the plant is stimulated to produce an enlarged stem. The goldenrod gall is a storehouse for the eggs of an insect and its hatching larva.

Experience B:

Materials needed:

Magnifying glass

What to do:	Discovering that:
Go out to a garden. Find and observe aphids on a plant with the magnifying glass. Watch their activity for 10 or 15 minutes. Note whether the aphids chew on the plants, suck juices from the plant, or merely walk over the plant. Formulate a conclusion concerning the importance of plants to aphids. Continue observing the aphids. Observe whether these specific kinds of aphids are on more than one kind of plant. Note whether there are any aphids on dead plants. Record all observations. Summarize the observations.	Aphids obtain their food by sucking juices of living plants.

Experience C:

Materials needed:

- Razor blade
- Magnifying glass
- Oak leaf gall

What to do:	Discovering that:
In late summer examine the gall on an oak leaf. Cut it open and examine the contents with a magnifying glass. Describe and identify what is found in the gall. Suggest an explanation for the formation of an oak gall.	Some insects lay their eggs in a part of a living plant. When some insects puncture the living tissue of an oak leaf to lay eggs, a growth is stimulated to form around the puncture area.

Concept #17 - Brushing the teeth thoroughly removes the food particles which supply nutrients for bacterial growth.

Experience A:

Materials needed:

- Toothpicks, 2
- Tooth brush
- Knox gelatine
- Tooth paste
- Crayon
- Test tubes, 2
- Sterile cotton
- Water
- Oven mitt
- Paper
- Pan
- Electric hot plate
- Wood, scrap, piece

What to do:

Prepare some unsweetened Knox gelatine. Fill several clean test tubes ½ full of the mixture. Twist a fluffed out wad of sterile cotton into the mouth of each test tube. Stand the tubes in a pan of boiling water for 20 minutes. Remove the test tube from the pan. Lean the test tubes on an object such as a scrap of wood, so that the upper end is slanted above the horizontal enough to keep the cotton plug dry. Allow the gelatine to cool and harden in this position. Number the test tubes with crayon or china marking pencil. Choose the child who seems to have the best set of teeth in the room. Ask permission from his parents to carry out the following activity: Have the child use the broadest edge of a wooden toothpick to scrape one of his teeth lightly before brushing. Twist the cotton plug out of test tube No. 1 and set it on a clean piece of paper. Deposit the scrapings from the toothpick onto the unsweetened Knox gelatine mixture in the test tube. Replace the plug of cotton in the test tube. Have the child brush his teeth thoroughly. Use the broadest edge of a second toothpick to scrape another tooth.

Discovering that:

Food particles left on the teeth are food for bacteria. Bacteria do not grow as rapidly on the teeth when fewer food particles are present.

Experience A (continued):

Deposit the scraping on the gelatine mixture in test tube No. 2 using the same careful procedure as with the first test tube. Allow the gelatine to stand, but not melt, in a warm, dark place for 3 days. Compare the size and number of colonies of bacteria growing on the food particles scraped from a tooth before and after brushing. Draw conclusions based on the results of the observation.

Concept #18 - Some living things depend on other living things to provide nourishment for them. (For these experiences the term "living things" is assumed to include recently alive, non-processed plant or animal materials.)

Experience A:

Materials needed:

Pencil
Paper

What to do:

Make a list of some of the common animals and the foods they eat for nourishment. See the chart below for some suggestions. Study the list to discover if any animals eat non-living things. Summarize the results.

Discovering that:

Many of the common animals depend on living things or recently living things for nourishment.

Animal	Food
Cow	Grass
Rabbit	Lettuce, carrots
Owl	Mice

Experience B:

Materials needed:

Plastic bag, unperforated
Rubber band

What to do:	Discovering that:
Kill a wild rat at a dump or other rat-infested area. (Use the freshly killed body of some other wild rodent if a rat is difficult to obtain.) Quickly place the warm body of the rat in a clear unperforated plastic bag. Seal it tightly by twisting a rubber band around the mouth of the bag. Place the bag in the dark for a day or two only. Bring the bag into the light and observe it carefully. (Most of these parasitic insects dislike the light and therefore the period of good observation is brief.) Do not open the bag. Record your observations. Explain the observations. Draw conclusions concerning the relation of the rat to the insects inside the bag. Have the building engineer dispose of the bag and its contents.	Many living things live on other living things (parasites). Many living things which are living on other living things are not always easily visible. When an animal carrying parasites dies, the parasites leave the dead animal.

Concept #22 - Some animals shift their food habits with the changes in food supply.

Experience A:

Materials needed:

Rabbit
Litter
Laboratory pellets
Water
Cage
Feeding dishes, 2
Watering device
Natural rabbit food

What to do:

Place the rabbit in a clean cage containing water and litter. Feed it the rabbit foods which it commonly eats until it is accustomed to the cage. Refer to The Book of Wild Pets by Moore for information about the care and feeding of the rabbit. After several days place a dish of laboratory pellets and a dish of its natural food in the cage. Watch the rabbit to see whether it changes in its food habits. Record the observations and draw conclusions based on the observations.

Discovering that:

Rabbits can change their food habits when there is a change in the food supply.

Experience B:

Materials needed:

- Salamander
- Aquarium tank
- Glass cover for aquarium
- Hamburger
- Mealworms (Tenebrio molitor)
- Lettuce
- Sand
- Shovel
- Charcoal
- Trowel
- Plants from habitat
- Soil

What to do:	Discovering that:
Make a terrarium which provides an artificial habitat as closely resembling the salamander's natural habitat as possible. Consult reference books to learn what kind of terrarium to make. Feed the salamander one or two mealworms (Tenebrio molitor) for several days. Form a ball of hamburger on the end of a blunt pencil. Move the hamburger in front of the salamander. Observe whether anything happens. Attach a small piece of lettuce on the end of the pencil and observe whether anything happens. Place a mealworm in front of the salamander and observe whether anything happens. Record the observations and draw conclusions based on the observations.	A salamander can be fed more than one kind of food. An adult salamander does not eat plant foods.

Experience C:

Materials needed:

- Monarch butterfly caterpillar
- Milkweed plant stem and leaves
- Elm twig and leaves
- Large glass jar

What to do:	Discovering that:
Place the caterpillar on the milkweed plant in a large jar. Look for evidence that it is eating. Move the caterpillar to the elm twig with leaves. Look for evidence that the caterpillar is eating. Record the observations and draw conclusions based on the observations. (If this activity is continued for several days, use fresh milkweed and elm leaves must be added.)	A monarch butterfly caterpillar apparently cannot shift its food habits.

Experience D:

Materials needed:

Mealworms (Tenebrio molitor)
Bran meal (Not borated or bromated)
Carrots
Dried beef
Wheat (Not borated or bromated)
4-Glass jars, small
Hand towel paper to shred

What to do:	Discovering that:
Place 10 mealworms and some shredded towel paper in each of the 4 small glass jars. Add bran meal to Jar No. 1, pieces of carrot to Jar No. 2, some dried beef in Jar No. 3, and unground wheat in Jar No. 4. Place each jar in a dark, warm place. Observe the jars monthly. Add more food as necessary. Count the number of mealworms in each jar at the end of six months. Decide which of all 4 jars contain food suitable for the mealworms.	Mealworms cannot shift food habits to take advantage of different kinds of food.

Concept #23 - Insects sometimes use food which could be used by other animals.

Experience A:

Materials needed:

- Aquarium tank
- Glass cover to fit aquarium
- Sod
- Young grasshoppers
- Charcoal
- Sand
- Gravel
- Soil
- Trowel
- Pencil
- Paper

What to do:	Discovering that:
List several common animals which eat grass. Place some young grasshoppers in a covered terrarium containing sod with growing grass. Water grass regularly. Observe the grass in the terrarium daily to discover if any changes occur. Explain the observations. Draw conclusions based on this experience.	Grasshoppers eat grass, a kind of plant which cows can use for food.

Experience B:

Materials needed:

Pencil
Paper
Reference materials

What to do:

Consult reference materials for help in making a list of common insects which use the blood of other animals for food. See the chart below for some suggestions. Make a summary statement explaining the food relation between some blood-sucking insects and their warm-blooded hosts.

Discovering that:

Some insects live on blood sucked from other animals.

Insect	Animal Supplying Blood (Host)
Mites	Rabbit
Ticks	Dog
Fleas	Bird, Cat
Mosquito	?

Experience C:

Materials needed:

Pet dog, cat or other tame furry animal
Magnifying glass
1-Small capped medicine vial
1-Common pin or sewing needle

What to do:

Examine your furry pet for any evidence of mites, fleas, or ticks (parasites). If your pet scratches often, examine those parts scratched for small hard lumps or granules deep in the fur. If present on your pet, these parasites usually will be found in the folds of skin around the base of the ears, eyes or where the legs of your pet join the body. If you find a small hard chunk of material deep in your pet's fur, remove it gently. Examine the chunk carefully under your magnifying glass with a pin or sewing needle. If you find that the small chunk is an animal parasite, place it in a small medicine vial for observation. If you give your pet a good bath regularly, you will not find these common parasites in the fur. If you find a parasite in your pet's fur, you should give him a good soap bath or dust his fur with DDT under your parent's supervision.

Discovering that:

Some common fur-bearing pets may have mites, ticks, or fleas which suck blood for their food.

Experience D:

Materials needed:

Wormy apple

What to do:	Discovering that:
Examine an apple which contains a worm. Note how the appearance of the fruit is changed. Explain why wormy apples are not eaten by some people. Explain why a worm in an apple is an insect. Explain the food relation of apple worms and other animals.	Some insects can change food to make it less attractive for human consumption.

Concept #24 - Insects are considered essential to some plant and animal life.

Experience A:

Materials needed:

1-Honeybee, preserved or recently killed
Magnifying glass

What to do:	Discovering that:
Carefully examine a dead bee with a magnifying glass. Observe and record by drawings or a description of the outside covering of the bee. Explain how this outside covering enables the bee to carry plant pollens. Explain the contribution which bees make to the life cycle of a plant.	The hairy outer covering of a bee aids in carrying pollen from one flower to another for pollination.

Experience B:

Materials needed:

A garden, park, or field of flowers
Insect net
Magnifying glass
1-Small glass jar (baby food) or medicine vial

What to do:	Discovering that:
Go out into a garden, park, or field of flowers in early fall or late spring. The class might take a study trip to a park or garden of flowers. Look for a honeybee or a butterfly on the flowers. Try to follow the insect to see on how many flowers it may alight or enter. After recording the observations, catch the insect with the net. Place the live insect in the jar or vial. Use a magnifying glass to observe the covering of the insect. Explain how a bee or butterfly could carry pollen from one flower to another. Relate the observations to formulate an explanation of the importance of a honeybee or butterfly to the life cycle of flowering plants.	Bees and butterflies contact many flowers in a day. Bees and butterflies carry pollen easily because of the structure of their body.

Experience C

Materials needed:

Ant colony including aphids
(usually found among plants)
Magnifying lens

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What to do:

Very often the plants near an ant hill will contain aphids which help furnish food for the ants. Locate a number of ant hills among the plants in a garden, flower bed or lawn. Examine carefully with the magnifying lens the leaves, or blades and stems of the plants near each ant hill. Small, almost colorless or light green insects, called aphids or plant lice, will often be found on the plants. These aphids suck plant juices for food. Very often the ants protect the aphids and will be found stroking the antenna or body of the aphids. During this process the aphids secrete, through tiny tubes located on the upper rear surface of their abdomen, drops of liquid, called "honeydew" which the ants eat for food. By this method ants can secure quantities of food indirectly from plants through "slave" aphids.

With your hand lens examine plants near ant hills for aphids. Then watch the ants "milk" honeydew from the aphids.

Discovering that:

Ants may use aphids to provide their food.

Concept #25 - Many plants are usually necessary to furnish the food for one herbivore.

Experience A:

Materials needed:

Rye or oat seeds
Rabbit in cage
3-Flower pots, 3" diameter
Fertile soil, 5 lbs.
Water

What to do:

Fill the 3 flower pots with soil. Plant a very small number of rye or oat seeds in one pot of soil; a larger number of seeds in another pot of soil; and still more seeds in the third pot of soil. Water the pots moderately and set them aside for a week to allow the seeds to germinate. Count the number of rye seedlings growing in each pot and record on the inside of each pot. Let the hungry caged rabbit eat the seedlings from the first pot. An hour later note whether it has eaten all the seedlings. Let it eat the seedlings from the second pot. An hour later introduce the third pot of seedlings to the rabbit cage to see if it still eats more of the seedlings. Count the number of uneaten seedlings in each pot. Determine the total number of seedlings eaten by the rabbit in one day. Formulate a statement concerning the relationship between the number of seedlings eaten in one day to the number of seedlings required for food for a year. Draw conclusions based on the statement.

Discovering that:

Many plants are needed to satisfy the food demand of one rabbit at one feeding. An enormous number of seedlings could be eaten by a rabbit in one year.

Concept #26 - Wild animals rove over a large area seeking an adequate supply of food.

Experience A:

Materials needed:

An unused vacant lot or meadow
Pencil
Paper
Reference materials

What to do:	Discovering that:
Go to a vacant lot or meadow. Locate close to the ground the tunnel of a meadow mouse through old grass or weeds. (It is necessary for the teacher to locate this ahead of time to be assured of a tunnel.) Follow the tunnels to learn how far they go. Record the observations with a sketched chart of the area. Consult reference materials which describe the feeding habits of the meadow mouse. Suggest an explanation for the observed length of the network of tunnels.	Meadow mice rove over a comparatively large area in search of food.

Experience B:

Materials needed:

Trowel or spade
Reference materials

What to do:	Discovering that:
Locate a gopher's (striped ground squirrel, pocket gopher or mole) hole or tunnel. Use a trowel or spade to dig up the ground to trace the tunnel(s). Observe the length of the tunnels. Consult reference materials which describe the habits of the kind of gopher whose tunnel has been dug out. Formulate an explanation for the length of the tunnels.	Gophers dig tunnels over a fairly large area. Gopher tunnels are necessary to the animal's method of getting food.

Concept #27 - Some animals are gregarious

Experience A:

Materials needed:

Pencil
Paper

What to do:	Discovering that:
Observe and record activities and behavior of starlings or martins in a neighborhood. Note the kind of house or nests in which they live. Observe whether they live near or have anything to do with other birds. Record all observations daily for several days. Formulate statements explaining the relation of starlings or martins to each other and to other birds.	Some birds live in groups.

Experience B:

Materials needed:

Trowel

What to do:	Discovering that:
Watch the ants in an ant hill. Observe how many ants appear to live in an ant hill. With the trowel dig up the ant hill. Observe whether the ants work together to rebuild the ant hill or if the ants separate and each makes a different ant hill. Draw conclusions based on the observations.	Many ants live together in one ant hill.

Experience C:

Materials needed:

Pencil
Paper

What to do:	Discovering that:
Watch wild ducks and geese during fall or spring migration. Note whether the ducks and geese fly alone or in groups. Record as many observations as possible for a week. Draw conclusions based on the observations.	Ducks and geese appear to migrate in groups.

Concept #31 - Animals which are natural prey of other animals often are able to escape due to the surroundings or speed of movement.

Experience A:

Materials needed:

Paper
Pencil

What to do:

Make a chart listing some common animals and their common enemies. Include in the chart a brief description of the animal's methods of escape of their enemies. See the chart below for some suggestions. Study the list of methods of escape to determine those methods most commonly used. Summarize the results.

Discovering that:

Camouflage and/or speed of movement are common means of protection or methods of escape from enemies.

Animal	Enemy	Methods of Escape
Rabbit	Fox	Run and hide in a hole
Snake	Hawk	Hard to see, move fast
Deer	Man	Run, color hides them

Concept #32 - Some animals have protective colorations.

Experience A:

Materials needed:

Glass jar with cover
Insect net
Leaves
Tree bark

What to do:	Discovering that:
Turn on an outside white electric light in late spring or early fall during a warm evening. Catch one of the nocturnal moths. Place it in the glass jar with a cover. Put in some leaves, bark from a tree and other common things found out of doors. Observe similarities and differences in coloration between each moth caught and placed in the jar. Observe whether the coloration of the moths makes them hard to see while resting on certain objects in the jar. Draw conclusions based on the observations concerning the coloration of moth as a protection from enemies.	Some moths are scarcely visible while resting on certain backgrounds because of their coloration.

Experience B:

Materials needed:

Animal pictures

What to do:	Discovering that:
Make a collection of colored photographs to show animals in their natural environment which is similar to their coloration; e.g., fawn, snake, rabbit, pheasant. Look closely at the pictures to discover whether the color alone or the pattern is the reason the animal is sometimes difficult to be seen. Draw conclusions based on the observations.	Many animals are difficult to locate because of coloration, which may include color and/or pattern.

Experience C:

Materials needed:

Bird pictures
Reference books

What to do:	Discovering that:
Make a collection of pictures of birds, both male and female, in their natural habitat. Compare the differences in color and pattern. Make an exhibit illustrating the difference in the amount of camouflage between a male and a female bird in its natural habitat. Prepare a report using this exhibit which explains the possible importance of color and patterns to birds as a way of escaping notice by their enemies.	The subdued coloring of the female acts as a means of protection because she is not so easily visible by possible enemies. The bright color of the male often attracts the attention of enemies while the female is well camouflaged.

Concept #33 - Some living things form protective coverings which enable them to survive unfavorable conditions.

Experience A:

Materials needed:

- Microscope slide
- Compound microscope
- Water
- Medicine dropper
- Pan
- Glass jar, about 1 qt. capacity
- Caked mud from a dry pond
- Teaspoon
- Rice or wheat
- Reference materials
- Pencil
- Paper

What to do:	Discovering that:
Collect some caked mud from a dry pond in late August or September. Spread a very small amount of dry mud on a microscope slide. Add a drop of water. Use a compound microscope to look for small plants and animals. Look for dark green or black spherical objects which are protective coverings around microscopic plants and animals. Record the observations by making a sketch of those objects located. Boil 3 or 4 grains of wheat or rice for 20 minutes in a quart of water. Cool the solution. Place about a teaspoonful of the mud in the rice or wheat solution. Let it stand about a week in a warm place. Put a drop of this solution on a microscope slide. Use the compound microscope to look for small plants and animals and for dark green or black spherical objects. Record the observations as sketches. Examine some of this solution every few days to look for any changes. Record the observations with sketches. Compare the observations. Draw conclusions based on the comparison. Consult references for further information.	Some animals and plants form protective coverings in order to survive periods of time with very little moisture but resume growth and the normal life cycle when adequate moisture and food become available.

Concept #34 - Animals have various ways of protecting young.
(Contributes also to concepts #35 and #36.)

Experience A:

Materials needed:

Pencil
Paper
Reference books

What to do:

Make a list of some common animals, indicating how the mother protects the young from enemies or predators. See the chart below for some suggestions for the list. Consult reference books for help in preparing the list. Draw conclusions based on a study of the chart.

Discovering that:

Many animals protect their young.

Mother	Protection
Hen	Baby chicks cuddle under the body and wings of mother.
Doe	Fawn often are protected when mother fights an enemy.
Cat	Kittens are often moved by the mother to a safer place.
Birds	Young birds are sometimes given warning by an alarm note.
Beaver	Beaver kittens are warned when an adult slaps his tail on the surface of the water as a signal of danger.

Experience B:

Materials needed:

Mouse--pregnant female *
Cage
Litter
Laboratory chow
Water
Feeding dish
Watering device

What to do:

Bring a pregnant mouse into the classroom for study. Provide a clean cage, litter, food and water for the mouse. Keep the cage clean and supply fresh food and water daily. Watch to see how the mother cares for the young after they are born. Draw conclusions based on the observations.

Discovering that:

Mother mice protect and care for their young.

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* These can sometimes be bought at a pet shop, secured from a research laboratory, or sometimes a child will bring a new mouse family to the classroom for study.

Experience C:

Materials needed:

Pencil
Paper
Mother cat and newborn kittens

What to do:	Discovering that:
Observe a mother cat as she feeds and takes care of her newborn kittens. Record all observations. Watch to see if the mother cat reacts differently to the appearance of strangers near her kittens. Draw conclusions based on the observations.	Some mother cats are very protective of their newborn young.

Concept #41 - Wildlife plays an important part in the balance of nature.

Experience A:

Materials needed:

2-Aquarium tanks, 6 gallon size
Snails, many
1 doz-Aquatic plants
10 lbs-Gravel, washed
10 lbs-Sand, washed
1 gal-Water, dechlorinated

What to do:	Discovering that:
Prepare two aquariums with plants as nearly identical as possible. Refer to pages 491-495 in the 1958 edition of "Science for the Elementary-School Teacher" by Craig in which some helpful suggestions will be found. Place a large number of snails in one aquarium. Place only a few snails in the second aquarium. Observe the plants in both aquariums daily for a period of time. Record the observations. Draw conclusions on the observations.	If there are too many snails in an aquarium, they eat the leaves off the plants. Too many things of one kind may completely destroy another living thing. If the plants and animals are in proper balance, both kinds of living things continue to live.

Concept #43 - Most green plants need air, sunlight, minerals and water.

Experience A:

Materials needed:

5-Lima bean seeds
Fertile soil
Water, about 1 cup per day
Low dish, plate or soup bowl
Blotting paper, about 30 square inches
2-Flower pots, about 5" diameter

What to do:

Cut the blotting paper into two equal sized sheets. Place one sheet of blotting paper on the low dish. Moisten it and place the lima bean seeds on the wet blotter. Wet the second blotter and cover the beans with it. Set the dish in a warm, dark place. Examine the seeds about every half day. Add more water to the dish and blotters as needed, to keep the seeds moist. Record the changes observed after about three days. After about three days plant the sprouted seeds in the two pots filled with moist fertile soil. Keep one pot in the dark. Place the second pot in the sunlight. Water as needed. Observe daily and record any changes. Draw conclusions based on the observations.

Discovering that:

Seeds sprout if kept moist in a dark, warm place. Sprouted seeds do not grow into healthy plants if they are kept in the dark. Plants need sunlight to grow.

Experience B*:

Materials needed:

- 2-Glass jars, with covers
- 6-Paper towels
- Water
- 10-Lima bean seeds
- Masking tape
- Thermometer, Fahrenheit

What to do:	Discovering that:
Place a thick pad of paper towels in the bottom of each glass jar. Add enough water to moisten the towels. Place at least 3 lima bean seeds in each jar. Cover the seeds with a folded sheet of moist paper towel. Place the cap securely but not tightly on both jars. Place one jar outside the classroom on the window ledge and the second jar on the window ledge inside the classroom. Record the outdoor and indoor temperature at least four times each day at the same time. Compare the sprouting and growth of each set of lima bean seeds. Draw conclusions based on the observations.	One of the requirements for seed germination is warmth (some heat).

* This experience should be tried during cold but not freezing weather.

Concept #48 - Some plants have structures which may protect them from enemies.

Experience A:

Materials needed:

Nettle leaf (Urticaceae family)
Magnifying glass, 10x or better
Glove, leather
Soap
Water
1 tsp.-Baking soda or dilute ammonium hydroxide

What to do:	Discovering that:
Use the glove on your hand to grasp the leaf of a nettle plant. Use the magnifying glass to examine the small points along the edge of the leaf. Have the teacher or a pupil volunteer to touch one of the projections on the leaf with the soft skin on the back of a bare finger. Use the magnifying glass to view the results on the leaf edge and on the finger. Note any change in the skin color. Have the teacher or pupil describe the feeling in the finger. Have the pupil or teacher wash the finger thoroughly in soda water or ammonium hydroxide afterwards to decrease the irritation caused by the plant acid.	The small projections at the edge of a nettle leaf act as small hypodermic needles and release an irritating fluid when they pierce some animal's skin. Special structures on some plants act as a protection from some animals.

Experience B:

Materials needed:

Seeds with hard shells
Knife

What to do:	Discovering that:
Make a collection of seeds with hard shells, e.g., butternuts, acorns. Use a knife to cut open the shells if possible. Compare the amount of effort used in each case. Develop a hypothesis to explain the importance of hard shells on these seeds.	The hard covers of some seeds are very difficult to open. The shells on some seeds protect the seeds from being eaten by some animals.

Experience C:

Materials needed:

Five-leafed ivy, Virginia Creeper or Woodbine leaves
Box elder leaves
1-Poison Ivy leaf (caution: collect only with disposable gloves)
Gloves, disposable
10-Glass plates, 4" x 6" or larger
1 roll-Cellulose or masking tape

What to do:

Collect leaves from Virginia Creeper or Woodbine, Box elder and any other plants in the area whose leaves resemble those of poison ivy. Have the teacher use gloves to collect and handle a leaf of poison ivy. (Dispose or thoroughly clean the gloves immediately.) Put the poison ivy leaf between two pieces of glass and enclose the edges with tape. Mount other leaves in the same manner. Compare the leaves as to size, shape and color. Discuss the importance of the use of a strong soap in washing parts of the body if exposed to poison ivy. Explain why gloves are used to handle poison ivy and are not used for the other leaves. Discuss the reason for disposing of or immediately and thoroughly cleaning the gloves. Develop a hypothesis to explain the importance of the poison to the poison ivy.

Discovering that:

Some plants produce a poison on their leaves. Some plants which slightly resemble poison ivy are not poisonous to the skin. Some plants may be protected from some animals by the poison produced by the plants.

Concept #49 - Most kinds of plants are adapted to living in the air.

Experience A:

Materials needed:

Aquarium tank
2-Potted plants, coleus
Water

What to do:	Discovering that:
Use 2 potted plants approximately the same size. Care for one plant as usual, taking particular care not to over water. Place the other plant in the aquarium filled with water so the plant is completely underwater. Observe both plants daily for one week and record the observations. Draw conclusions based on the observations.	A coleus plant cannot live in water.

Concept #50 - Some plants are adapted to living under water.

Experience A:

Materials needed:

Aquarium tank
2-Aquatic plants, rooted
Flower pot
Fertile soil

What to do:	Discovering that:
Use 2 rooted aquatic plants approximately the same size. Cover the roots of one of the plants in the aquarium with sand or gravel. Pot the other plant in fertile soil. Water it regularly. Observe both plants daily for one week and record the observations. Draw conclusions based on the results.	Some plants are adapted to living in the water and cannot live out of water.

Concept #51 - Some plants are adapted to live in shady, cool areas and others live in sunny, warm areas.

Experience A:

Materials needed:

None

What to do:	Discovering that:
Make a study trip out in the school grounds or to a home near the school. Observe carefully all the plants you see on the trip. Compare the plants found in the shade on the north side of the building with the plants found in the sun on the south side. Examine and compare the shapes and size of the leaves, the kinds of stems, and the characteristics of the flowers. Record all observations of the shade and sun plants. Draw conclusions based on the observations.	The plants which grow well in the sun differ from the plants which grow well in the shade. Different kinds of plants may have different light requirements for good growth.

Concept #52 - Some plants and animals transmit diseases

Experience A:

Materials needed:

Pencil
Paper
Reference materials

What to do:

Make a list of diseases and the names of the plants and/or animals which carry or transmit human diseases. See the chart below for some suggestions for the list. Consult reference materials for additional information. Draw conclusions based on a study of the chart.

Discovering that:

Many plants and animals are disease transmitters or carriers.

Disease	Hosts
Yellow fever	Mosquito
Parrot fever	Parrot, parakeet
Undulant fever	Rabbit
Malaria	Mosquito
Sleeping sickness	Fly
Colds	Humans
Whitepine blister rust	Currants
Dutch elm disease	Bark beetles

Experience B:

Materials needed:

None

- -

What to do:	Discovering that:
Listen to a talk by school nurse or doctor in regard to communicable diseases and their prevention. Discuss how these diseases are spread and explain how to prevent these diseases from spreading.	Self-quarantine is an important step in the prevention of communicable diseases.

Concept #56 - When exposed to light, green leaves release oxygen and water to the atmosphere.

Experience A:

Materials needed:

Potted plant, small
2-Glass jars, about 1 quart capacity
Cardboard, corrugated, about 4" x 4"
Modeling clay
Scissors

What to do:	Discovering that:
Cut a ½" wide strip out of the corrugated cardboard from one edge to the center. Slip the piece of cardboard across the top of the flower pot until the stem of the plant passes through the slot to the center of the cardboard. Push the cut cardboard strip back into the slot in the cardboard up to the stem. Seal the cardboard around the stem with modeling clay. Invert one quart jar over the plant and rest the mouth of the jar on the cardboard. Place the plant covered by the jar in the sunlight. Turn the second quart jar upside down beside the plant. Observe both quart jars at hourly intervals and compare their appearance. Explain why the two jars look different. Draw conclusions based on the observations.	Plants give off water vapor which condenses on the inside of the glass jar.

Experience B:

Materials needed:

- Potted geranium, small
- Rubber band
- Polyethylene bag, very large
- Wood splint
- 2-Test tubes
- Match
- 2-Corks to fit the test tubes

What to do:	Discovering that:
Place the geranium stem and leaves, the test tubes and the corks inside the bag. Twist the rubber band around the opening of the bag to seal it at the base of the plant. Place the bag containing the plant in the sunlight for several days. Push the corks firmly into the openings of the test tubes. Open the bag and remove the test tubes. Use a match to light the wood splint. Blow out the flame after it has burned 20 seconds to obtain a glowing splinter. Remove the cork from one test tube and immediately place the glowing splinter into the opening of the test tube. Observe what happens. Repeat the test for oxygen using the second test tube. Explain how the extra oxygen got into the plastic bag. (If more oxygen is present than normally occurs in air, the glowing end of the splinter may burst into flames.)	Plants release oxygen into the atmosphere when exposed to the light.

Concept #57 - Most green plants in the presence of light are able to release oxygen as a by-product of photosynthesis.

Experience A:

Materials needed:

- Match
- Elodea plant growing in an aquarium
- Water
- Glass funnel, short stem
- Test tube, about ½" x 5"
- Glass plate
- Wood splint

- -

What to do:

Place the aquarium in the sunlight. Invert a funnel over the Elodea plant in the aquarium. Fill the test tube with water and invert it over the upturned stem of the funnel. Make sure the opening of the test tube is not raised out of the water to admit air. Observe the test tube every hour looking for small bubbles rising into the test tube. Allow the test tube to remain until it has become ½ full of gas. Remove the test tube, keeping the opening of the test tube pointed down and under the surface of the water. Cover the opening of the test tube with a glass plate or your thumb. Remove the test tube from the water and turn it upright. Use a match to set fire to a wood splint. Allow the splint to burn for about 20 seconds and then blow it out. Insert the glowing wood splint at the opening of the test tube as the glass plate is removed. Observe whether the splinter does not change, glows more brightly, or bursts into flame. (Oxygen is the only common gas which may cause the splint to glow or flame.) Draw conclusions based on the observations.

Discovering that:

Oxygen is released by a green plant during photosynthesis.

Concept #58 - Plants are directly or indirectly dependent on the soil.

Concept #59 - Soils provide a medium suitable for the growth of many plants.

Experience A:

Materials needed:

5-Aluminum meat-pie tins
Brick
1 pkg-Radish seeds
2 cups-Sawdust
2 cups-Fertile soil
2 cups-Sand
2 cups-Clay
Water

What to do:	Discovering that:
Place some radish seeds on the brick. Wet the brick and keep it moist in a warm area. Fill one of the five pie tins with sawdust, one with fertile soil, one with sand, one with clay and one with water. Plant some radish seeds 1/8" deep in each material. Place in a warm area. Keep the material in each container moist and observe to see in which containers the seeds germinate. Compare the rate of development of the seeds in the different materials. Draw conclusions based on the comparison.	Seeds which are placed in unfavorable places do not survive and grow. Seeds placed in favorable materials grow.

Experience B:

Materials needed:

3-Flower pots, about 3"
1 qt.-Fertile soil
1 qt.-Sand
1 qt.-Clay
1 doz-Lima beans
Water
Pencil
Paper

What to do:	Discovering that:
Fill the three pots with a different kind of soil in each. Plant some lima beans in each pot. Water each pot of soil and beans. Keep the pots in a warm and lighted area. Observe and keep a record of the growth of the beans in each pot. Compare the growth of the beans in the three pots. Draw conclusions concerning the importance of soil to plant growth.	Soil which contains minerals and water is needed for bean plant growth. Some soils provide a better environment for plant growth than others.

Concept #60 - Most plants cannot obtain dissolved minerals and water from the air but must secure it from the soil.

Experience A:

Materials needed:

Fertile soil
Glass plate
2-Coleus plants approximately the same size

What to do:	Discovering that:
Pot one plant in fertile soil and place the other plant on a piece of glass. Water the potted plant and place both plants in sunlight. Examine the plants each hour. Compare the plant whose roots are obtaining minerals and water from the soil to the plant entirely surrounded by air only. Draw conclusions based on the comparison.	A coleus plant which receives minerals and water from the soil continues to grow. A coleus plant entirely surrounded by air dies because it is not able to secure the needed water and dissolved minerals.

Experience B:

Materials needed:

Corn or lima bean seeds
Washed sand
Fertile soil
2-Flower pots, about 3" diameter

What to do:	Discovering that:
Plant some corn or lima bean seeds in a flower pot containing washed sand. Moisten the sand and set the pot in a warm place. Plant some corn or lima bean seeds in fertile soil. Moisten the soil and set the pot in a warm place. Observe the pots daily and record the results. Compare the results of the two plantings for three weeks and draw conclusions based on the comparison.	Seedlings not able to get minerals from fertile soil do not develop normally.

Concept #61 - Some plants contribute to the formation of soil.

Experience A:

Materials needed:

None

What to do:	Discovering that:
Go to a forest or the north slope of a hill containing exposed rocks. Look for lichens, moss, or other small plants growing on a rock. Dig up the plants and note whether the rock is crumbling beneath the plant. Look for another rock of the same kind which does not have a plant growing on it. Note whether this rock is crumbling. Draw conclusions based on the observations concerning the effect of plants on the weathering of rock and the formation of new soil.	Plants help break down rock and form new soil.

Experience B:

Materials needed:

Woodland soil
Magnifying glass

What to do:	Discovering that:
Examine in detail some soil from a wooded area with a magnifying glass. Make a list of all of the kinds of things found in this soil. Make sketches of types of material found. Note whether parts of dead plants are decomposing and becoming a part of the soil. Draw conclusions based on the observations.	Decayed plants are part of soil.

Experience C:

Materials needed:

Lima beans
Fertile soil
Flower pot, about 3" diameter
Glass plate, single strength, about 3" square
Dish
Water

What to do:	Discovering that:
Plant 5 or 6 lima beans in a pot of soil. Place the bottom of the pot in a shallow dish of water. Keep in a warm, light place. Put a glass plate over the top of the pot. Observe if, as the seeds grow, the stems lift the glass from the top of the pot. Develop a hypothesis which will explain how the force of growing plants can be important in soil formation.	A growing plant exerts much force as it grows. Growing plants may force rocks to split into small pieces.

Concept #62 - Plants, in order to remain successful in an area, must have an adequate supply of water.
(Also contributes to Concept #7)

Experience A:

Materials needed:

3-Pots of lima bean seedlings, about 2" high
- Water
- Pencil
- Paper

What to do:	Discovering that:
Use 3 pots of lima beans which have grown to approximately the same size. Number the pots. Water pot #1 very heavily, pot #2 an average amount and pot #3 a very small amount every other day. Observe and record the changes over a period of two weeks. Compare the records for the seedlings in the three pots. Draw conclusions based on the comparisons.	Bean plants must have the right amount of water in order to grow best.

Concept #63 - Seeds may be dispersed by environmental factors.

Experience A:

Materials needed:

Pencil
Paper

What to do:	Discovering that:
Take a walk to an unused lot. Observe where seeds are found. Examine the seeds found on the plants and on the ground. Note how far a seed is found from the plant on which it grew. Relate the shape and size and covering of each seed to the distance it seems to have spread. Develop an hypothesis to explain how each seed is moved. Make a chart summarizing the information.	There are many shapes and sizes and coverings of seeds. Seeds can be found in many places. Some seeds are on the ground close by the parent plant and some are far away from the parent plant on which they grew. Seeds are dispersed by environmental factors such as wind, water, animals.

Experience B:

Materials needed:

Reference books
Seed collection
Saran Wrap
Cellulose tape

What to do:	Discovering that:
Make an exhibit or display of as many kinds of seeds as you can find. Place each kind of seed between layers of Saran Wrap and tape the edges if necessary or put them in small plastic containers; e.g., large size ampules which can be obtained from a veterinary supply company. Label each container to show the various ways the seeds are dispersed; e.g., "sticker," "parachutes," "propulsion." Sort the seeds into groups determined by the method of dispersal. Consult reference books for helpful information. Prepare a report for the class which summarizes the information.	Seeds have different shapes. The shape of a seed is sometimes associated with the means of dispersal.

Experience C:

Materials needed:

Seed from Experience B
Cardboard, 12" x 12"
Cardboard, ½" x 1½"
Crayon

What to do:

Make a game about the methods of seed dispersal. Use the seed packets from Experience B. Tape a small cardboard on the back of each packet with the words describing its method of dispersal. Have a piece of large cardboard divided into more large squares than there are methods of dispersal. Label the squares with the descriptive words for the methods of dispersal, one in each square. Make a large question mark in the extra squares. Take turns sorting the seeds. Place any packets of seeds whose shape does not give the right clue in the square marked with a question mark. Check each child's work by turning the packet over and comparing the back of the packet to the label in the square on which it rests.

Discovering that:

The shape of some seeds give a clue about how these seeds are scattered.

Concept #64 - Man is dependent on plants to furnish food, clothing, shelter and some medicine.

Experience A:

Materials needed:

Pencil
Paper

What to do:

Make a chart listing the ways plants help man. See the chart below for some suggestions. List some names of specific plants under each heading.

Discovering that:

Man is dependent on plants to furnish many things used in everyday living.

Food	Clothes	Shelter	Medicine
Apple tree	Cotton	Maple tree	Belladonna
Sugar beet	Flax (linen)	Pine tree	Foxglove
Hard maple tree (make sugar)			Poppy opium
Wheat			
Cabbage			

Experience B:

Materials needed:

Pencil
Paper

What to do:	Discovering that:
Go to the grocery store. Make a list of all the things on the shelves which do not come from plants. Draw conclusions based on this list.	Man is very dependent on plants for his source of food.

Experience C:

Materials needed:

Pencil
Paper

What to do:	**Discovering that:**
Go to a department store. List the things on their shelves or in stock which are made from plants; e.g., furniture, cotton cloth. Draw conclusions based on the results.	Many things used by man in his everyday living come from plants.

Concept #65 - Fossils furnish information about the organisms and types of habitats on the earth in the past.

Experience A:

Materials needed:

Geologist's hammer
Magnifying glass

What to do:	Discovering that:
Take a study trip along the banks of the Mississippi River. Collect fossils. Do not collect fossils in Minnehaha Park. Examine them with a magnifying glass. Compare them to the live plants or animals we have today. Note the type of rock in which they are found. Explain what information is provided by the identification of the rock type. Draw conclusions concerning the type of habitat in which the fossilized material lived and grew.	Some fossils were from plants and animals somewhat similar to the plants and animals living today. The fossils and the types of rock in which the fossils are found give evidence that the present banks of the Mississippi River were formed on an ocean bottom.

Experience B:

Materials needed:

None

What to do:	Discovering that:
Make a display or exhibit of fossils collected from other areas of the world. Try to relate the fossils with plants and animals that are living today. Draw conclusions based on the study.	Fossils from many different areas indicate some similarities between prehistoric living things and the plants and animals that are living today.

Concept #66 - Fossils are formed only from plants and animals which have hard parts.

Experience A:

Materials needed:

Pan, about 8" x 8" x 1½"
Water
Mud, soft
Plastic or wax paper
Leaf

What to do:	Discovering that:
Spread several sheets of plastic or wax paper over the bottom of the pan and extend them over the ends of the pan. Lay a leaf on the plastic or wax paper with the coarse veins up. Fill the pan with a layer of soft mud. Keep the mud moist and warm. Allow the project to stand for at least one month. Turn the pan over and use the plastic sheet to pull the layer of mud away from the pan. Remove the wax paper. Peel the leaf carefully from the leaf print. Observe the leaf and leaf print carefully. Record the observations. Replace the leaf and wax paper exactly. Put the pan back in position. Turn the entire project over and store until the following month, keeping the mud moist at all times. Note which parts of the leaf leave the impression. Draw conclusions based on the observations.	Fossils are formed only by the harder parts of a plant since the soft parts gradually decompose.

Experience B:

Materials needed:

- Fish, about 6" long
- Pan, about 8" x 8" x 2"
- 2 lbs. Plaster of Paris
- Water
- 1 jar Vaseline
- Brush, small, soft bristled
- Teaspoon
- Beaker, 400 ml., Pyrex
- Cup

What to do:

Obtain a fish about 6" long. Put it in a shallow pan. Set the pan in an animal cage. Place the cage on the roof. Examine the fish at weekly intervals to note whether the soft parts are decomposing. Bring the fish back to the classroom when only the skeleton remains. Remove the pan from the cage. Place the jar of vaseline in a beaker of water and heat it to melt the vaseline. Use a soft bristled, small brush to apply a thin coat of liquid vaseline to the skeleton bones and to the pan. Be careful to avoid moving or breaking the bones when applying the vaseline with the brush. Prepare a very thin plaster of Paris mixture by using about 2 teaspoonfuls of plaster of Paris to 2 cups of water. Pour this into the pan and allow the liquid to evaporate, and the plaster of Paris to set. Apply melted vaseline again to the skeleton and to the plaster of Paris surface. Lay the skeleton on the first layer and pour a second layer of thin plaster of Paris over the skeleton to completely cover it. Let stand until hardened. Try to separate the plaster of Paris layers to see the "fossil" print that has been created. (In a true fossil, the soft part is decompomposed and no longer present.) Explain how this process is similar to the process which went on over many thousands of years to create the fossils found today in our rock.

Discovering that:

Fish bones are hard enough to form fossils. Fossil forming materials are covered by many different layers of material.

Experience C:

Materials needed:

- Reference materials
- Plaster of Paris
- Water
- Shell from an aquatic animal
- Vaseline
- Wax milk carton
- 1-Coffee cup

What to do:

Coat a sea shell with vaseline or an oil. Pour a cupful of plaster of Paris into a clean coffee cup, add a little water and stir. Add more water, if necessary, until the mixture is about the consistency of thick cream. Pour this mixture into the lower part of a waxed milk carton. Wait until the plaster starts to "set" and then push the outer surface of the shell firmly into the plaster to the widest part of the shell. Let the plaster set. Remove the shell carefully. Look closely at the imprint. Compare it with the shape of the surface of the shell. (Actually chemicals in the water of the earth would very gradually dissolve the sea shell leaving a fossil print, but since there is no simple way to remove the shell in this way, simply pull it out carefully to look at the imprint.) Consult reference materials to learn how the hardening of plaster of Paris simulates the formation of sedimentary rock. Draw conclusions based on the results.

Discovering that:

An imprint of a shell can be made in plaster of Paris. Prehistoric shells could have formed imprints in sedimentary rock as it was being deposited.

Experience D:

Materials needed:

- Vaseline
- Plaster imprint made in Experience B
- Plaster of Paris
- Water

What to do:

Coat the entire plaster surface of the imprint prepared in experience C including the shell indentation with melted vaseline. Mix the same quantity of plaster of Paris. Pour the mixture on the vaselined plaster surface of the imprint. Let it set for an hour or so. Carefully separate the two pieces of hardened plaster of Paris. Note whether a casting of the "fossil" imprint has been formed. Draw conclusions based on the observations.

Disccvering that:

Fossils are sometimes made indirectly from parts of plants and animals.

Concept #67 - Fossils of plants and animals are usually found in sedimentary rock.
(Also contributes to Concepts #65 and #66.)

Experience A:

Materials needed:

Reference materials

What to do:	Discovering that:
Take a field trip down along the Mississippi River near the Minnehaha Falls area. Look for fossils in the limestone cliffs. Consult references to learn how limestone is formed. Explain why fossils forms are found in limestone.	Limestone rocks contain fossils. Limestone is a sedimentary rock, which carries the impressions of animals and plants which died during its formation.

Experience B:

Materials needed:

Fossil samples

What to do:	**Discovering that:**
Examine fossils collected in different areas. Identify the type of rock in which each fossil is found. Draw conclusions based on the results.	Fossils occur in several kinds of sedimentary rock.

Experience C:

Materials needed:

None

What to do:	Discovering that:
Make a study trip to the Science Museum in St. Paul or the Science Museum of the Minneapolis Public Library. Look closely at the fossils on exhibit and try to determine what types of rocks contain the fossils. Note if any fossils occur in rocks which are not sedimentary in origin. Summarize the observations and information.	Fossils occur in several kinds of sedimentary rock.

Concept #68 - Very little accurate information about dinosaurs is available.

Experience A:

Materials needed:

Reference materials
Paper
Pencil

What to do:

Consult many scientifically accurate references about all kinds of dinosaurs. Avoid using popularly written reference sources since they are lax in differentiating between facts and guesses. Make a chart divided into three columns as illustrated below. List in these three columns: (1) Reference, (2) Facts, (3) Guesses. Under the column entitled "Facts," list all information about dinosaurs, which we know to be true. Under the column entitled "Guesses," include all information about dinosaurs which we think may be true, even though we do not have supporting evidence. Separate the information from different references by drawing a double line horizontally across the chart. Compare the information from the different references to see if all references agree. Study the chart and draw conclusions.

Discovering that:

Very little accurate information about dinosaurs is available. Authors disagree in their writing about dinosaurs because much of the information about dinosaurs is still a guess.

Reference	Facts	Guesses

Experience B:

Materials needed:

Wire, thin and pliable
Bones, small, from different kinds of animals
Pencil
Paper
Turtox Service Leaflet No. 9

What to do:

Make a collection of small, clean bones from different kinds of animals. Refer to the Turtox Service Leaflet No. 9 for suggestions on the steps in the preparation of clean bones. Remove about a dozen clean bones from the collection. Pretend that these bones are fossils of different animals mixed together just like geologist found them. Try to construct a skeleton or skeletons from these bones using thin pliable wire to join the bones together. Use this skeleton to determine the shape and size of an animal and draw a picture of the animal. Discuss the problem of obtaining accurate information about dinosaurs based on fossil evidence. Draw conclusions based on the experience. (Scientific guesses are based on much evidence and greater background of knowledge concerning the types of bones found in animals.)

Discovering that:

Scientists make many guesses when describing extinct animals of which we find only fossil or bones as evidence.

IV. BIBLIOGRAPHY FOR TEACHERS

A. BOOKS

Buchsbaum, Ralph and Mildred. 1957. Basic Ecology, Boxwood. Excellent definition of ecology.

Craig, Gerald S. 1958. Science for the Elementary School Teacher, Ginn and Company. Contains basic background information - teaching suggestions - suggested learning experiences.

Department of Public Instruction, Bismarck, North Dakota. 1961. Elementary Science Handbook for Elementary Schools of North Dakota. A sourcebook containing suggestions for experimentation demonstrations, student projects and general information.

Moore, Clifford B. 1954. Book of Wild Pets, Branford, Boston. Excellent reference on care and feeding of native wildlife in captivity - identification guide and life habits of wild pets - pictures, diagrams, suggestions for teaching.

Navarra and Zafforoni. 1960. Science Today for the Elementary School Teacher, Row, Peterson and Company. Suggestions and experiments which can be carried on in the classroom. Chapter 12 - "Web of Life" - very helpful.

V. BIBLIOGRAPHY FOR CHILDREN

A. BOOKS

Bartlett, Ruth. 1957. Insect Engineers, Wm. Morrow & Co. Information about the anatomy, social habits and engineering feats of various kinds of ants. Average reading level.

Blough, Glenn. 1960. Discovering Dinosaurs, McGraw. Facts about fossils. Easy reading level.

Darby, Gene. 1960. What is a Plant?, Benefic. Contains an interesting section on pollination and seed dispersal. Easy reading.

Green, Ivah. 1951. Partners With Nature, Van Nostrand. Stresses the struggle of animals, plants and people working together. Average reading.

Green, Ivah. 1955. Animal Masquerade, Coward - McCann. Protective devices of animals (land, sea and air). Average to read.

Keen, Martin. 1961. How and Why Wonder Book of the Microscope, Merrill. Introduction to microscopic plant and animal life. Average to difficult.

Lubell, Winifred. 1960. Tall Grass Zoo, Rand McNally. Introduces animals found in the tall grass of any suburban community. Easy reading.

McClung, Robert. 1954. Bufo, Story of a Toad, Morrow. Tells about the first three years in the life of a toad. Average reading level.

McClung, Robert. 1957. Luna, Story of a Moth, Morrow. Description and illustrations of the life cycle of a moth.- Average reading level.

Neal, Charles D. 1961. What is a Bee?, Benefic. Information on life cycle; function of a bee in pollination. Easy reading.

Parker, Bertha. 1958. Animals Round the Year, Harper Row. Animals prepare for winter - color change, food storage, hibernation, migration, cocoon. Average reading level.

Parker, Bertha. 1952. The Golden Treasury of Natural History, Golden Press. Valuable as a reference book on almost any phase of natural history. Average to hard reading.

Posin, Dan G. 1961. What is a Dinosaur?, Benefic Press. Good explanation of why dinosaurs died out. Average reading.

Rood, Ronald. 1960. Of Insects, Merrill. Presents essential facts in life cycle of insects, fossil formation. Average to difficult.

Rood, Ronald. 1960. Of Ants and Bees, Merrill. Presents essential characteristics of four families of social insects - bees, wasps, ants and termites. Excellent color illustrations. Average to difficult.

Selsam, Millicent E. 1958. See Through the Lake, Harper. Exploring a community of plants and animals that live at different levels in a lake. Average.

Selsam, Millicent E. 1961. Underwater Zoos, Morrow. How to set up and maintain an aquarium. How to collect specimens for an aquarium. Difficult reading level.

Syrocki, B. John. 1961. What is Soil?, Benefic. Tells about soil composition. Easy reading.

Zim, Herbert. 1950. Frogs and Toads, Morrow. Information on habitat, life cycle, anatomy and protection of frogs and toads. Good diagrams. Easy reading.

Zim, Herbert. 1950. What's Inside of Plants?, Morrow. Information about the way plants grow; make food. Easy reading.

VI. BIBLIOGRAPHY OF INSTRUCTIONAL FILMS

Film	Producer
Adventures of a Chipmunk Family	EBF - 1958 - 11 color
Animal Habitats	Film Associates - 1955 - 10 color
Animal Homes	Churchill-Wexler
Animal Life at Low Tide	Pat Dowling
Animals in Spring	EBF - 1955 - 11 color
Animals in Summer	EBF - 1954 - 11 color
Animals in Autumn	EBF - 1957 - 11 color
Animals in Winter	EBF - 1950 - 11 color
Aquarium Wonderland	Pat Dowling
Beach and Sea Animals	EBF - 1931 - 11 sd b & w
Bear Country	Disney - 1956 - 33 color
Beaver Valley	Disney - 1953 - 32 color
Butterfly Botanists	Coronet - 1947 - 10 sd b & w
Changing Forest	McGraw-Hill
How Nature Protects Animals	EBF - 1939 - 11 sd b & w
How Plants Help Us	McGraw-Hill
Insect Foods	Pat Dowling
Joey and the Ranger	
Life Along the Waterways	EBF - 1952 - 11 color
Life in a Garden	McGraw-Hill
Little Animals	Pat Dowlihg
Mammals of the Western Plains	Coronet - 1947 - 10 sd b & w
Microscopic Wonders in Water	Pat Dowling
Olympic Elk	Disney

BIBLIOGRAPHY OF FILMS (continued)

Partnerships Among Plants and Animals	Coronet - 1959 - 11 color
Seal Island	RKO Radio - 1949 - 27 sd color
Seasonal Changes in Plants	McGraw-Hill
This Vital Earth	EBF - 1948 - 10 color
Toads	Pat Dowling
Wonders in a Country Stream	Churchill-Wexler
Wonders in the Desert	Churchill-Wexler
Wonders in Your Own Backyard	Churchill-Wexler

Note: See Instructional Film and Filmstrip lists provided in "The Grade Four Supplement to the Reorganized Science Curriculum".

VII. SUMMARY LIST OF SUGGESTED EQUIPMENT & SUPPLIES

Aerator
Aluminum pie tin
Animal pictures
Ant colony among plants
Aquarium tanks
Aquatic plants or animals

Baking pan, about 8" x 8"
Baking soda or dilute ammonium hydroxide
Beaker, 400 ml, Pyrex
Bean seeds
Bird pictures
Black paper
Blotter, about 30 sq. inches
Bog plants and animals
Bog soil
Bones
Box Elder leaves
Bran meal
Brush

Cage
Cardboard
Cardboard, corrugated, about 4" x 4"
Carrots
Cellulose tape, or masking tape
Charcoal
Cheese cloth
Clay
Clock
Coffee cup
Coleus plants
Common pin or sewing needle
Corks to fit test tubes
Corn seeds
Crayon
Cup

Dish
Dish pan
Dried beef

Electric fan
Electric hot plate
Elm twig and leaves
Elodea plant growing in aquarium

Feeding dishes
Fertile soil
Flower pots, 3" diameter
Flower pots, 5" diameter
Fish, about 6" long
Fossil samples
Funnel, glass

Garden, park or field of flowers
Geologist's hammer
Glass cover for aquarium
Glass jar, about one gallon capacity
Glass jar, baby food
Glass plate, single strength 3" square
Glass plates
Gloves, disposable
Gloves, leather
Glue
Grasshoppers
Gravel, washed

Hard boiled egg yolk
Honey
Honey bee, preserved or recently killed
Hygrometer, Humidiguide

Ice
Insect net
Ivy, five-leafed

Jar, with cap
Jars, large, one gallon, without caps
Jars, large, one gallon, with tight caps

Knife, sharp
Knox gelatine

Laboratory chow
Laboratory pellets
Leaf
Leaves

Lettuce
Lilac sapling
Lima beans
Lima bean seeds
Litter

Magnifying glass
Magnifying lens
Masking tape
Match
Mealworms
Medicine bottle
Medicine dropper
Medicine vial, small capped
Microscope
Microscope compound
Microscope slide
Milkweed plant stem and leaves
Modeling clay
Monarch butterfly caterpillar
Mortar
Mother cat and new born kittens
Mouse, female, pregnant
Mud, caked, from a dry pond
Mud, soft

Natural rabbit food
Nettle leaf
Newspaper or large sheet of plastic

Oak leaf gall
Oat seeds
Oatmeal box
Old shoe or rotten log
Oven mitt

Pan
Paper
Paper towels
Pencil
Pestle
Pet dog, cat or other tame furry animal
Pictures
Plants and animals from a desert habitat
Plants and animals from a Minnesota bog or swamp
Plants and animals from a Minnesota low woodland habitat
Plants from various habitats
Plaster of Paris
Plastic or wax paper
Plastic bag, unperforated
Plate
Polyethylene bag, large
Poison ivy leaves
Pond mud
Pond plants
Pond water
Potted geraniums
Potted plants, coleus
Potting soil

Rabbit in cage
Radish seeds
Razor blade
Reference materials and/or books
Rice
Rubber bands
Rubber cement
Rye or oat seeds

Salamander
Sand, washed
Saran Wrap
Sawdust
Scrapbook
Screen, coarse mesh
Screen, fine mesh
Scissors
Seed collection
Seeds with hard shells
Shell from an aquatic animal
Shovel
Small fish or minnows
Snails
Soap
Soil
Soup bowl, low
Spade
Spagnum moss
Sponge
Sterile cotton
Stone breaker

Tap water which has been standing one week
Teaspoon

Test tubes
Thermometer, centrigrade (celsius) or
   Fahrenheit scale
Tincture of iodine, diluted 5 times
   with water
Toad, tadpoles, small
Tooth brush
Toothpicks
Tree bark
Trowel
Turtox Service Leaflet No. 9

Unprocessed plants
Unused vacant lot or meadow

Vaseline
Virginia creeper leaves

Water, dechlorinated
Watering device
Wax paper
Wheat
Wire
Wood, scrap or piece
Wood splint
Woodbine leaves
Wooden boxes, about 12" x 18" x 2"
Woodland plants and animals
Woodland soil
Wormy apple

ROCKS

A Partial Unit

Grade 4, Science

This partial unit on rocks and minerals was developed during the in-service meeting at Mann School, December 10, 1964. Mr. Premo reviewed and edited the results.

The concepts and experiences listed here need not be presented in the order given. The manner and extent to which you will use these ideas should be determined by the needs of the children and your plans for the unit.

SCIENTIFIC APPROACH TO PROBLEM SOLVING

1. Observation - first-hand experiences and observation.
2. Definition of PROBLEM - ask questions, choose one for investigation.
3. Results of other investigators - read about problem, discuss it with interested friends and resource people, examine the written material.
4. Possible solutions - list all possible gueses.
5. Choosing the best solution (HYPOTHESIS) - pick the "best guess."
6. Testing the hypothesis - planning and carrying out EXPERIMENTS to determine its truth.
7. CONCLUSION of accepting or rejecting hypothesis - draw conclusion from experiments to determine acceptance or rejection of "best guess".
8. More extensive testing of hypothesis - experiment further to determine if hypothesis always holds true.
9. Stating the THEORY and publishing results - restate the hypothesis in light of the above experimentation, publish in professional journal.
10. Finding mathematical proof - do any measuring and mathematical calculations to develop proof of theory.
11. Statement of LAW or PRINCIPLE - If no one can find a mistake in the mathematical proof or develop a contrary proof, the theory becomes a law or principle.

Materials and equipment needed for the unit include:

From the school science supplies:

microscope
hand magnifying glasses
glass plate
rubber tubing
spring balance (scale)

From home or store

rocks of the area and identified
   specimens if possible
string
egg cartons
lemon juice or vinegar
penny
knife
paper bags
newspaper
pint jar and cover
sea shells
coffee can
pop bottle cap
teaspoon
aluminum foil
shoe box
milk carton
nearly empty toothpaste tube
pin
eye dropper
cigar boxes
unglazed porcelain (tiles)
hammer
soil
coarse sand or gravel
lime
fine sand
Portland cement
Plaster of Paris
rocks for special tests (granite,
   pyrite, hematite, mica, rock salt)
large, hard rock for a pounding surface
pebbles
heavy cloth bag

Elementary Science Handbook for the Elementary Schools of North Dakota, Department of Public Instruction, Bismarck, North Dakota, 1961

*The [illegible] *Investigating Science with Children* Volume 2, National Science Teachers Association, Teachers Publishing Corporation, Darien, Connecticut, 1964

Craig, Gerald S. *Science For The Elementary-School Teacher*, Ginn, 1958

Hone, Elizabeth, et al. *Teaching Elementary Science: A Sourcebook for Elementary Science*. Harcourt, Brace & World, Inc. 1962

Textbooks available in your building

Concepts	Activities	Materials
Rocks are classified by formation and composition Concept 1	Have the children collect rocks of the area. Let them suggest a variety of ways to classify them. This will provide background experiences for determining relationships and establishing groups. Classifications suggested might include shape, size, weight, texture. (It would be unwise to classify by taste for reasons of hygiene.) reference: ESH p. 260	magnifying glasses cigar boxes and string egg cartons
Rocks and minerals may be examined visually and some of them tested chemically to determine their classification and composition. Concept 2	Test for limestone by dropping lemon juice (or vinegar) on the surface of rocks. Those that "bubble" contain limestone. reference: ESH p. 261	lemon juice (or vinegar) eye dropper
Rocks contain minerals Concept 2a	Examine many rocks closely with a hand lens or microscope for crystals of minerals (Rock is a mixture of minerals; a mineral is a chemical substance not formed by plant or animal; minerals with definite geometric outlines are crystals.) The crystals that are almost colorless, pink, or smoky are probably quartz which is the most common mineral on earth. Classify by minerals. reference: ESH p. 261	hand lens microscope rocks with conspicuous minerals (e.g. granite)

[illegible]

[illegible]

Test for streak by drawing rocks across unglazed porcelain. Classify by color of the streak. (The streak is made by the mineral in the rock.)
reference ESH p 234

Test for luster (the amount of light reflected) by observing
Metallic
Non-metallic
Vitreous (glossy)
Pearly
Resinous
Greasy
Silky
Waxy
Dull or earthy
(Do not impose this classification. Let the children use their own words to describe luster)
reference ESH p 234

Test for hardness (resistance to scratching)
(for MOH scale see ESH p 234)
May be (fingernail - rating: 1-2½
scratched (copper coin - rating 3
by (knife - rating: 5
(glass - rating: 5½-6

Test for **cleavage (breaks along a plane)** or fracture (breaks irregularly) **by breaking** rocks in a heavy cloth bag with a hammer. Try rock salt and examine results under the microscope. Try other minerals as well.

unglazed porcelain
(tile)
pyrite (black streak)
hematite (reddish
brown streak)
Try any rock that
looks metallic

penny
knife (or pop bottle
cap)
glass plate

heavy cloth bag
hammer
mica
rock salt
microscope

Concepts	Activities	Materials
All rocks of the same kind are not the same color. Concept 3	Classify rocks by color. The children can observe that colors change with handling and weathering. Also note that many rocks have more than one color. Therefore this kind of classification is often misleading.	
The color of a rock is of little value in identifying the specimen. Concept 4	Break open a rock and compare the outside color and the inside color.	large, hard rock for a pounding surface heavy cloth bag hammer
	Wash rocks to see if the original color will appear. Compare the wet rock with the inside of the broken rock. reference: Craig p. 284	water
	If possible, locate many types of quartz and many types of sandstone. Classify by color. Examine the classification to note that the same rock type is in many different color groups	samples of quartz samples of sandstone

Concepts	Activities	Materials
In rapidly flowing streams rocks are smooth and rounded because they are rolled and tumbled by the force of water Concept 7	Place a large flat rock on newspaper. Rub a smaller rock over it. Note that rock dust will result, and it will become part of the soil. Discuss where and how rocks could be rubbed together in nature.	large, flat, hard rock small softer rock
Physical changes in rocks are caused by exposure to the changing weather Concept 10	Place some freshly broken sedimentary rocks in a jar and keep some out. Have several children (10 or more) shake it 100 times each. Note the water. Allow the sediment to settle or filter it out and examine the sediment on the filter paper. Compare tumbled rock pieces with those that were not tumbled. Have the sharp edges been worn away? Why? reference: ESH p. 265	paper towel or filter paper funnel
	Break open rocks. Compare the appearance of the exterior and the interior. What caused the differences? reference: ESH p. 261	large rock for pounding surface heavy cloth bag hammer
	Place a soft stone (sandstone, limestone) under a dripping faucet. Examine the rock the next day. reference: ESH p. 271	
	Carefully weigh a piece of dry, porous rock. Soak overnight in water. Weigh again. Place the rock in the freezing compartment of a refrigerator. How could these things happen to rocks in nature? reference: ESH p. 271	spring balance (or a kitchen scale) porous rock: limestone or sandstone
	Make a Plaster of Paris rock with a crack in it. Measure the crack. Pour in water and freeze the rock overnight. Measure the resulting crack. reference: Craig p. 286	Plaster of Paris milk carton or box

Concepts	Activities	Materials
Most rocks do not burn Concept 8 Rocks are not melted easily Concept 9	Do not attempt experiences to develop these concepts. There is great danger in attempting to burn or melt many types of rocks. Children can discuss the concepts and the safety factors of scientific investigation.	

Concepts	Activities	Materials
(Rocks are formed in various ways Concept 12)		
Sedimentary rocks are formed of materials which are carried by wind or water into lakes or oceans Concept 17	The most common sedimentary rocks are sandstone, limestone, shale, and conglomerate. Find out how sediments settle in water to form layers. Mix sand, gravel and soil. Add water and pour some of the mixture into a jar. As it settles siphon off some of the water, and add another layer. Continue until the jar is filled. Observe the layer structure.	coarse sand or gravel fine sand soil pint jar rubber tube
Sediments can be deposited by water running over low land Concept 18	Make an artificial sedimentary rock by adding dry Portland cement to the above mixture. Allow it to dry out. Carefully break the jar by putting it in a bag and striking it with a hammer in several places. Examine the new rock closely. reference ESM p. 268	small amount of plaster of Paris or Portland cement heavy cloth bag hammer
Sedimentary rock is formed by the compacting and cementing of individual particles in layers of sediments Concept 19	On an outline map of the United States locate the mouths of large rivers. Indicate off-shore regions where rocks probably are forming today. Using the map legend to help determine the elevation of the land near the mouth of the river will lead to discussion of the force of moving water. Make samples of types of sedimentary rocks shale: cement and water limestone: lime, plaster, and water (use lemon juice or vinegar to test the rock) sandstone: sand, cement, and water conglomerate: pebbles, fragments of sea shells cement, and water Pull off the cartons when the mixture has hardened. reference: Hone p. 116	milk cartons cement lime plaster lemon juice (or vinegar) sand pebbles sea shells

Concepts	Activities	Materials
(Rocks are formed in various ways. Concept 12)		
Igneous rocks are formed by the cooling of molten materials. Concept 13	The most common igneous rocks are granite, basalt, diorite, pegmatite (course granite).	
	Squeeze toothpaste from one end of the tube to the other to show how molten magma moves. Roll the tube up tightly; then puncture the tube near the top with a pin. The contents squirting out acts much as molten rock erupting from a volcano. reference: Hone p 114	partly used tube of toothpaste pin
	Examine granite for three crystals of which it is composed: quartz - glass-like, translucent crystals mica - black or white, shiny, flaky crystals feldspar - pinkish crystals that are flat and rectangular reference: Hone p 115	magnifying glass microscope granite rocks
	There is, in some reference books, a demonstration volcano project. The demonstration involves building a model volcano from Plaster of Paris and newspaper or some other materials. Chemicals are then added to the center of this model volcano. There is very little, if any, direct teaching value to this demonstration, and there is considerable danger involved with these chemicals and their reactions. Teachers are therefore advised not to include this demonstration in their teaching unit.	

Concepts	Activities	Materials
Rocks are formed in various ways. Concept 12) Texture of rocks is changed by pressure and heat. Concept 11 A metamorphic rock is rock which has been changed by heat, pressure, and time Concept 16	The most common metamorphic rocks are. gneiss (pronounced "nice") which is metamorphosed granite quartzite which is metamorphosed sandstone marble which is metamorphosed limestone slate which is metamorphosed shale Compare gneiss and granite quartzite and sandstone slate and shale marble and limestone	rock specimens of gneiss quartzite marble slate hand lenses microscope rocks as stated

The following concepts may be included in fourth grade social studies units. Understanding can be developed by research and discussion.

18. Part of the earth, including some of Minnesota, is covered by volcanic igneous rock.

19. Pressures in the earth's crust may cause a change in the lower layers of rock found in the crust.

20. Rocks are useful to man in many ways.

23. Minerals, rock and ores are formed and located at various places on the earth's crust.

24. Minerals, rocks, and ores generally are consumed where they are economically profitable.

25. Some rocks in the earth's crust contain materials of economic value.

26. Some rocks in the earth's crust appears to be of little economic value.

27. Minerals, rocks and ores are used by industry.

28. Some types of rocks are used in building construction.

29. Coal, lignite and peat are not minerals; however, they are often referred to as mineral fuels.

30. Coal is usually a better fuel than either lignite or peat.

31. Natural gas is a fuel and should be used with care.

32. Petroleum is not a mineral; however, it is often referred to as a natural mineral.

33. Ores usually occur as deposits only in certain places and in unequal amounts.

34. Ores often must be refined to obtain the desired products.

35. Used or wasted minerals and rocks cannot be replaced.

36. Scientific and knowledge methods are used to conserve our natural resources.

37. Salt and water are used directly for the continuance of life.

Available through the Audio-Visual Department

Educational films -- see Science Motion Picture Films listing, Grade 6

Copper - Mining and Smelting

Drilling for Oil

Iron Ore Mining

Iron - Product of the Blast Furnace

Making Bricks for Houses

Making Glass

Mining Iron Ore

Treasures of the Earth

Volcanoes in Action

Earthworms

Seeds of Destruction

May be available in your school library or through the Board of Education [illegible]

Library Books -- see A Selective Bibliography of Books Found Useful in the Teaching [illegible]
Units, Grade 4

Oil, Today's Black Magic - Buehr

Rocks and the World Around You - Clemens

Junior Science Book of Rock Collecting - Crosby

Rock Oil to Rockets - Gringhuis

The Earth: Rocks, Minerals and Fossils - [illegible]

The How and Why Book of Rocks and Minerals - [illegible]

Rocks and Minerals and the Story They Tell - Irving

The First Book of Mining - Markun

Wonders of Rocks and Minerals - Pearl

The True Book of Rocks and Minerals - Podendorf

What is a Rock - Syrocki

Rocks All Around Us - White

Diamonds - Zim

Rocks and How They Were Formed - Zim

SF/lvl
2-3-65

MINNEAPOLIS PUBLIC SCHOOLS
Science Department

MEMORANDUM

To: Grade Four Supplement Holders

From: Science Department

Re: Resource materials for the Major Topic, Living Things, Grade 4

- -

A set of "Suitcase Loans" has been made available recently by the Science Museum of the Minneapolis Public Library. Many of these display cases are appropriate for use with the Grade 4 Major Topic -- Living Things.

The "Suitcase Loans" available are:

EXPLORING OUTDOORS

E-1 Bird Nest, Puffballs, Goat's Beard, Bracket Fungi.

E-2 Shelf Fungus, Mud Dauber Nest, Tumbleweed, Galls, Lichens.

E-12 Exploring Outdoors - Pebbles, Bird's Nest, Galls, Shelf Fungus, Lichens.

E-13 Exploring Outdoors - Galls on a twig, Rocks with fossils, Mud Dauber wasp nest, Goat's Beard, Puffballs on tree bark.

These materials may be checked out and returned only at the Main Library. They are charged on your library card.

Since they are about 30" x 24" x 5", it would seem advisable to select only one or two cases at any one time. The "Suitcase Loans" are display cases containing mounted specimens and a glass front. Each case stands erect and could be used to stimulate interest in the unit or for continued motivation. These cases may be kept for as long as thirty days, but it may be advisable to change them more frequently.

Please inform the Science Office of your reactions to this material. Perhaps we can be instrumental in providing guidelines for the development of future suitcase loans.

JLP:md
9-22-65

MINNEAPOLIS PUBLIC SCHOOLS
Science Department

MEMORANDUM

To: Grade Four Supplement Holders

From: Science Department

Re: Resource Materials for the Unit, Rocks and Minerals, Grade 4

A set of "Suitcase Loans" has been made available recently by the Science Museum of the Minneapolis Public Library. Many of these display cases are appropriate for use with the Grade 4 Unit -- Rocks and Minerals.

These materials may be checked out and returned only at the Main Library. They are charged on your library card.

Since they are about 30" x 24" x 5", it would seem advisable to select only one or two cases at any one time. The "Suitcase Loans" are display cases containing mounted specimens and a glass front. Each case stands erect and could be used to stimulate interest in the unit or for continued motivation. These cases may be kept for as long as thirty days, but it may be advisable to change them more frequently.

Please inform the Science Office of your reactions to this material. Perhaps we can be instrumental in providing guidelines for the development of future suitcase loans.

The following two pages contain a list of the "Suitcase Loans" available at this time.

ROCKS AND MINERALS

R-5 Crust of the Earth is made of Rocks-
Igneous Rocks - Scoria, Basalt, Obsidian, granite.
Sedimentary - Sandstone, Limestone, Conglomerate, Coal.
Metamorphic - Slate, Schist, Quartzite, Gneiss.

R-6 Crust of the Earth is made of Rocks -
Igneous Rock - Scoria, Basalt, Obsidian, Granite.
Sedimentary - Sandstone, Limestone, Conglomerate, Coal.
Metamorphic - Slate, Schist, Quartzite, Gneiss.

R-7 Interesting Rocks and Minerals -
Amygdaloidal basalt, fossil rock, Geode, Quartz Crystal, Agate.
Fool's Gold, Iron Ore, Azurite.

R-8 Interesting Rocks and Minerals -
Fossil Rock, Quartz Crystal, Montana Agate, Geode, Amygdaloidal basalt, Iron Ore, Petrified Wood, Basalt (see Lichens), Cat's Eye.

R-9 Crust of the Earth is Made of Minerals -
Calcite, Galena, Copper Ore, Fool's Gold Chrysocolla, Asbestos, Rose Quartz, Quartz Crystal, Mica.

R-10 Crust of the Earth is Made of Minerals -
Calcite, Galena, Copper Ore, Fool's Gold Chrysocolla, Asbestos, Rose Quartz, Quartz Crystal, Mica.

R-13 The Fossil Record
Brachiopods, Shark's tooth, Fossil Jaw, Fossil leaf, Petrified Wood.

R-14 The Fossil Record
Fossil fern leaf, trilobite, mammal tooth, Shark's tooth, fossil clams, Petrified Wood.

R-15 The Fossil Record
Brachiopods, Fossil leaf, Fossil Jaw, Coral, Shark's tooth, Petrified Wood.

R-16 The Fossil Record
Fossil snails, mammal tooth, Petrified Wood, Fossil leaf, limestone with fossils.

R-17 Interesting Rocks and Minerals
Mica, Petrified wood, iron pyrite, polished jasper, thomsonite, agates, fossil leaf, basalt, quartz crystals.

R-18 Interesting Rocks and Minerals
Mica, Geode, asbestos, iron pyrite, quartz crystal, sand crystals, fossil leaf, fossil shell, petrified wood.

R-19 Interesting Rocks and Minerals
Fossil leaf, sand crystals, quartz crystals, barite rose, sand nodules, rose quartz, garnet schist, petrified wood, polished granite.

R-20 Interesting Rocks and Minerals
Mica, calcite, iron pyrite, quartz crystals, jasper, agate, fossil leaf, obsidian, Oregon Thunder egg.

R-22 The Rock Groups
Igneous - Obsidian, Porphyry, granite.
Sedimentary - Coal, Limestone, Sandstone.
Metamorphic - Schist, Gneiss, Slate.

R-23 The Rock Groups
Igneous - Obsidian, Granite Basalt.
Sedimentary - Sandstone, Limestone, Iron Ore.
Metamorphic - Gneiss, Schist, Slate.

R-24 The Rock Groups
Igneous - Obsidian, Granite Basalt.
Sedimentary - Limestone, Sandstone, Coal.
Metamorphic - Marble, Schist, Slate.

R-25 The Rock Groups
Igneous - Granite, Obsidian, Basalt.
Sedimentary - Limestone, Sandstone, Coal.
Metamorphic - Schist, Quartzite, Slate.

R-26 The Rock Groups
Igneous - Porphyry, Basalt Obsidian.
Sedimentary - Coal, Sandstone, Limestone.
Metamorphic - Slate, Marble, Schist.

R-27 The Rock Groups
Igneous - Granite, Scoria, Gabbro.
Sedimentary - Sandstone, Limestone, Conglomerate.
Metamorphic - Schist, Quartzite, Gneiss.

September 22, 1965

MINNEAPOLIS PUBLIC SCHOOLS
Science Department

USE AND CARE OF PERMANENT MAGNETS
(Bar Magnet, U-Magnets, V-Magnets, Horseshoe Magnets, etc.)

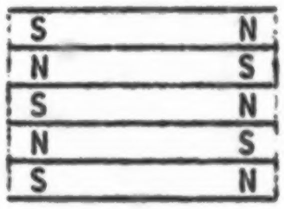
I. Introduction

When a piece of steel (Alnico or other Iron Alloy) is permanently magnetized, all or most of the molecules, each of which is a tiny magnet, are moved so that their poles are all in the same direction. This requires the use of a very strong electromagnet to magnetize our permanent magnets. Evidence of the above theory may be demonstrated by carefully cutting a bar magnet in two with a hacksaw. Each piece is a magnet with a north and south pole. If this cutting is continued *ad infinitum*, we theorize that each molecule will be or is a tiny magnet.

If permanent magnets are not cared for properly, they will lose their magnetism rapidly. The purpose of this note to you is to help you to keep your magnets useable for an extended period of time.

II. Storage

The magnetic field around a permanent magnet requires energy for maintenance. Magnetic lines of force do not pass easily through air (Impermeability). It is advisable when storing permanent magnets to connect the poles with soft iron "keepers". When you received your bar magnets from the supplying company, there were soft iron "keepers" across the ends in the box. Bar magnets may be stored on top or at the side of each other by reversing the position of each magnet so that the polarity will alternate in the pile.



If you have lost the "keepers" for your permanent magnet, make some out of heavy gauge sheet iron, iron nails, iron bolts, etc. Place keepers on all permanent magnets when not in use. Keepers will become only temporarily magnetized while in use.

III. Use

Magnets lose their energy very rapidly during use by

1. Dropping, beating, or pounding
2. Heating
3. Placing in a strong magnetic field with reversed polarity

You should teach your students regarding these methods of demagnetizing as precautions in the care of permanent magnets. In junior high and senior high schools where equipment is available, the demagnetizing of magnetized tools, watches, clocks, and the like may be illustrated.

If by accident your permanent magnets are demagnetized or need reenergizing, please send them to the Science Department at the Administration Building, or call 332-4284, for information.

JHS/lvl 2-26-65

SOME IDEAS ON HOW TO MAKE MICROSCOPE SLIDE MOUNTS

By: Dr. J. Hervey Shutts
Consultant in Science
Minneapolis Public Schools

Plant Cells

1. Remove a very small piece of thin brown onion skin from a dry onion. Place it on a clean microscope slide and moisten it with a drop of water. When the skin has become completely soaked by the water, cover the slide with a second microscope slide. Place the double slide on a compound microscope and look for starch crystal and cell wall structure of the dead plant cells.

2. Cut an extremely thin slice of cork from a commercially prepared cork stopper using a sharp, single edge razor blade. Mount the slice on a microscope slide with a drop of water. Cover with another microscope slide and place the double slide on the compound microscope. Near the edge of the slice, where it is thin, look for the walls of the dead plant cells.

3. Remove the thin dry layers on the outside of a fresh onion. Hold the onion steady on its side on the surface of a table. Use a sharp single edge razor blade to cut a very thin slice from the upper round surface of the onion bulb. Place the slice on a microscope slide with a drop of water. Cover with another microscope slide. With a compound microscope view the edge section of the slice to locate a place thin enough for study of the cell structures.

4. Remove a leaf from an Elodea plant in your aquarium. Mount it in a drop of water between two microscope slides. Place the slides on a compound microscope. Look for "streaming" protoplasm in the living cell plant, using at least 100X magnification.

5. In a similar manner to No. 3 make a very thin tangential slice of the outer covering (commonly called the peel) of a potato. Mount it with a drop of water between two microscope slides. Place on a compound microscope and examine the cell structures.

6. In a similar manner to No. 3 make a very thin tangential slice of a peeled potato. Mount the slice in a drop of water between two microscope slides. Place on a compound microscope and examine for cell structures and contents. In these cells you will be able to distinguish starch granules. Examine them carefully as to general size and shape.

7. Starch granules have different characteristic appearances according to their origin in Irish potatoes, field corn, wheat, oats, barley, lima beans, popcorn. Examine these and other forms under the compound microscope if time permits. Examine some corn starch as purchased from the grocery store, on a microscope slide under a compound microscope to identify its origin by shape and size of starch granules.

Animal Cells

1. Cut a small cork stopper in half. Cut a very thin slice of any fresh or fixed animal tissue to be studied. Cut a narrow strip of material from the thin slice. Place the strip between the two halves of the cork stopper. Use a very sharp, single edged razor blade to cut a very thin slice of cork and tissue. Continue slicing until the section cut contains a very good transparent area of the animal tissue for study. Mount the tissue on a slide in a drop of water. Use a second slide to cover the tissue if desired. Look for the characteristic shape, size and contents of these animal cells. A pencil sketch on paper may help you to remember the appearance of some of the cells.

2. Place a drop or two of blood on a microscope slide near one end. Rest one end of a second microscope slide on the first slide. Pull it along until it contacts the drop of blood and then push it rapidly to the other end of the first slide, spreading the blood the length of the slide. Place a few drops of Wright's Blood Stain on the "blood smear" slide and drain over a watch glass or caster dish. Dry the slide by slightly warming, not heating, over a Bunsen burner or candle. Look for red blood cells as coins which are thin in the center or as stacks of coins.

For Examination of Pond Life

1. Heat some water in a beaker. Place a smaller container of petroleum jelly (vaseline) in the beaker to melt the vaseline. Dip a cylindrical object with a smooth circular open end (cutter for hole in doughnut or test tube without a rim) into the melted vaseline. Place the end of the cylinder flat against a cool microscope slide. Remove the cylinder and allow the vaseline ring to solidify. Use a medicine dropper to place a small amount of freshly collected pond water inside of the ring. Use a cover glass to cover the ring if desired. Look for evidence of plant and animal life with a compound microscope. If you have collected your pond water in the right place you may have some fairy shrimp, water fleas and pieces of algae.

JHS:nm
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